University of Belgrade

Faculty of Mechanical Engineering

Course Catalog

Ph.D. (doctoral) Studies

Table of contents

Adaptive Structures

ID: PhD-3254
teaching professor: Simonović M. Aleksandar
ECTS credits: 5

goals

Study of theoretical backgrounds and applying of advanced research methods related to adaptive structures. Development of creative abilities for R&D and specific engineering problems approach using contemporary adaptive structures design and analysis methods.

learning outcomes

Vast and comprehensive field of adaptive structures is covered with contemporary topics. Advanced adaptive structures topics included, enable extended analysis and design of adaptive structures of various types and purposes.

theoretical teaching

Comply with the subject of the research of the candidate's doctoral thesis

practical teaching

prerequisite

learning resources

number of hours

lectures: 35
research: 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

D. Wagg, I.Bond, P.Weaver, M.Friswell, ADAPTIVE STRUCTURES: ENGINEERING APPLICATIONS, Wiley, 2007
M.Wiedemann, M.Sinapius, ADAPTIVE, TOLERANT AND EFFICIENT COMPOSITE STRUCTURES, Springer, 2013
A.V. Srinivasan, D.M. McFarland, SMART STRUCTURES - ANALYSIS AND DESIGN, Cambridge University Press, 2001.
T.H.Brockmann, THEORY OF ADAPTIVE FIBER COMPOSITES, Springer, 2009
Selected Journal Articles

Advanced Algorithms in Technical Engineering

ID: PhD-3383
teaching professor: Radojević LJ. Slobodan
ECTS credits: 5

goals

The aim of the subject is to introduce a PhD student with some algorithms that are typical for programming operating systems Mechatronic devices. In this case, the typical algorithms for autonomous robotic Mechatronics systems. These algorithms have a basic feature: through time they are online.

learning outcomes

The doctoral candidate will identify processes that are characteristic of Mechatronics systems and processes at the same time operating system. Also, the doctoral candidate will be able to divide complex processes mechatronic systems in more simple process.

theoretical teaching

1. Banker's algorithm without feature process.
2. Banker's algorithm with the features of the process.
3. Classic Round Robin - RR algorithm.
4. Non-classical RR algorithm.
5. Processes with urgent priorities in the non-classical RR algorithm.
6. Processes with highest priorities in the non-classical RR algorithm.
7. Standard priority processes in non-classical RR algorithm.

practical teaching

PhD student will become familiar with the work of RR algorithm and servicing process. Recognize different processes characteristic of Mechatronics systems and apportioned them according to features that will mapped in priorities. Nonclassical RR algorithms allow different treatment processes were characterized with priorities. Analyzing a number of Case studies Ph.D. candidate will identify processes of three classes: urgent, high-priority, and classical.

prerequisite

C or C++

learning resources

The necessary software for this course under the GNU license - free of charge.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 0; calculation tasks: 0; seminar works: 45; project design: 0; final exam: 50; requirements to take the exam (number of points): 50

references

Advanced Course in Air Conditioning

ID: PhD-3371
teaching professor: Živković D. Branislav
ECTS credits: 5

goals

Capacity development for the individual and team work in the field of air conditioning. Development and synthesis of complex technical solutions, related to the Ph.D dissertation.

learning outcomes

Expert with a significantly expanded and deepened knowledge in the field of air conditioning. PhD student who listenes to and passes this course is capable to independently observe, formulate and solve problems using modern methods, independently and in a team organize and conduct research, makes objective conclusions and to suggest appropriate solutions.

theoretical teaching

Calculation of unsteady heat transfer through the building envelope by transfer functions method. The simplified calculation methods derived from the transfer functions methods. Air contaminants and odors. Air cleaners. Humidifiers and dehumidifying process. Space air diffusion and room air distribution equipment. Applied heat pumps and heat recovery systems. Testing, adjusting and balancing HVAC systems. Commissioning of HVAC installations in building. Operation and maintenance costs. Building energy management. Control strategies and optimization. Sound and vibration control.

practical teaching

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prerequisite

There are no requirements

learning resources

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number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

ASHRAE Handbook - Fundamentals, ASHRAE Publication Sales, Tullic Circle NE, Atlanta Georgia 2009
ASHRAE Handbook - HVAC Applications, ASHRAE Publication Sales, Tullic Circle NE, Atlanta Georgia 2011
ASHRAE Handbook - HVAC Systems and Equipment, ASHRAE Publication Sales, Atlanta Georgia 2008
Scientific and technical papers related to the specific topics

Advanced Course in Numerical Methods for Ship Strength Analyses

ID: PhD-3188
teaching professor: Motok D. Milorad
ECTS credits: 5

goals

Learning methods for structural analyses of advanced ship structures.

learning outcomes

Student will be capable of conducting structural analyses of advanced ship structures using commercial software.The emphasises is on static and dynamic analyses of steel and composite structures using finite element method (FEM).

theoretical teaching

Advanced FEM technics. Calculation of basic modes of free hull girder oscillations. FEM analyses of ship hulls made of composite materials.

practical teaching

Training for use of commercial FEM software in solving above explained tasks.

prerequisite

Defined by the curriculum of studies.

learning resources

1. Commercial FEM computer programs
2. Instruction manual for commercial FEM programs use /In English/

number of hours

lectures: 35
research: 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: 0; project design: 100; final exam: 0; requirements to take the exam (number of points): 0

references

M. Motok: Ship Strength /In Serbian/, MF, Beograd 1995.
O.F. Hughes: Ship Structural Design, John Wiley & Sons, New York,1983.
C.T.F Ross: Advanced Applied Finite Element Methods, Harwood Publishing, Chichester,1998.
Ever J. Barbero: Finite Element Analyses of Composite Materials,Taylor & Francis Group, LLC, Boca Raton, 2008.

Advanced Course in Refrigeration

ID: PhD-3372
teaching professor: Kosi F. Franc
ECTS credits: 5

goals

Achieving of competence in individual and team research work in the field of refrigeration technology. The development of creative abilities of analysis and synthesis of complex technical refrigeration systems, in full accordance with the defined basic tasks and objectives of the study program.

learning outcomes

PhD student acquires specific skills to self-observe, formulate and solve relevant problems by using modern methods of testing and analysis of complex technical systems; as part of a team, organizes and conducts research, draws conclusions and proposes appropriate solutions.

theoretical teaching

Thermodynamic principles of refrigeration - binary mixtures: solubility, isobaric-isothermal mixing, evaporation of homogeneous liquid mixtures, azeotropy, Merkel (enthalpy-concentration) diagram, basic operation with binary mixtures.
Simultaneous heat and mass transfer between water-wetted surfaces and air, enthalpy potential, basic equations of heat and mass transfer processes for direct-contact equipment, evaporative condensers and cooling towers.
Heat exchangers: NTU analysis, finned-tube heat transfer, plate heat exchangers
Methods of producing low temperatures: expansion of vapors and liquids through a turbine, Joule-Thomson effect (throttling process, inversion temperature), endothermic mixing of substances.
Vapour compression refrigeration cycles: air cycle refrigeration systems, тhermodynamic modifications of standard vapour compression cycle, (subcooling, multistage throttling, multistage compression with intercooling), multi-evaporator system with individual compressor , cascade systems
Heat pumps: basics of heat pump, operating principles, thermodynamic analysis of heat pump cycle performance, classification of heat pumps, air-source heat pump (system performance, defrosting, controls), groundwater heat pump systems (ground coil heat pump systems and direct-expansion ground-coupled heat pump systems), hybrid (or twin source) heat pumps.

practical teaching

prerequisite

no specific conditions, useful basic knowledge in thermodynamics

learning resources

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Markoski M.: Refrigeration devices, Facultu of Mechanical Engineering, Belgrade, 2006
ASHRAE Handbook, 2009, Fundamentals, American Society of Heating, Refrigeration and Air-Conditioning, Engineers, inc., Tullie Circle, n,e., Atlanta, GA 30329.
ASHRAE Handbook, Refrigeration, 2010, American Society of Heating, Refrigeration and Air-Conditioning, Engineers, inc., Tullie Circle, n,e., Atlanta, GA 30329.
Jungnickel, H., Agsten, R., Kraus W. E.: “Grundlagen der Kältetechnik”, VEB Verlag Technik, Berlin, 1980.
Shan K. Wang, Handbook of Air Conditioning and Refrigeration, McGraw-Hill, Second Edition, 2001.

Advanced course of Mechanical and hydromechanical Operations and Equipment

ID: PhD-3262
teaching professor: Stanojević M. Miroslav
ECTS credits: 5

goals

The aim of the course is that students gain some knowledge about the processes, apparatus and devices for mechanical and hydro-mechanical operations, to prepare for further theoretical and experimental research in the PhD.

learning outcomes

The outcome of the course is that students gain some knowledge about the processes, apparatus and devices for mechanical and hydro-mechanical operations, to prepare for further theoretical and experimental research in the PhD.

theoretical teaching

Introduction. Characteristics of granular materials. Basic mechanical operations. The physical basis of mechanical grinding process. Processes and equipment for crushing and grinding. Processes and equipment for classification and screening. Theoretical basis for the operation of mixing of granular materials. Basic hydromechanical operations. Separation of gaseous and liquid heterogeneous systems setting chamber, cyclones, electrostatic precipitators, wet filters). Processes and equipment for filtration.

practical teaching

Students work under the supervision of teacher one seminar paper that needs student to apply knowledge.

prerequisite

There are no special requirements. For students whose doctoral thesis in the field of mechanical and hydro-mechanical equipment and operations.

learning resources

Bogner, M., Stanojević, M., Livo, L.: Cleaning and filtration gas and liquid, ETA, Beograd, 2006.
Laboratory installation for determining coal milling factor.
Laboratory installation for determining the physical properties of granular materials.
Laboratory installation for fluidization granular materials.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 25; calculation tasks: 0; seminar works: 40; project design: 0; final exam: 30; requirements to take the exam (number of points): 40

references

Magdalinović, N.: Fragmetation and classification, Naučna knjiga, Beograd, 1991.
Bogner, M., Stanojević, M., Livo, L.: Cleaning and filtration gas and liquid, ETA, Beograd, 2006.
V. Bhatia, Paul N. Cheremisinoff.: Solid Separation and Mixing, Technomic Publishing Company, Lancaster, USA, 1979.

Advanced Digital Control Systems

ID: PhD-3024
teaching professor: Bučevac M. Zoran
ECTS credits: 5

goals

Mastering with: advanced techniques for analysis and synthesis of digital control systems

learning outcomes

Knowledge of advanced techniques for analysis and synthesis of digital control systems.

theoretical teaching

Analysis in time domain. Analysis in frequency domain. Advanced design methods. Advanced digital control algorithms. Design of a digital controller system. The state estimation. Implementation.

practical teaching

• Direct tracking of the course theory through the illustrative examples,
• Define and elaborate of the task of seminar paper,
• Consultation.

prerequisite

There are no requirements.

learning resources

• Manuscript at http://au.mas.bg.ac.rs/Nastava-Kau/Nastava_Download.htm
• Moudgalya, K.M.: Digital Control, John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, 2007.
• Digital computer.

number of hours

lectures: 35
research: 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: 70; project design: 0; final exam: 30; requirements to take the exam (number of points): 30

references

Moudgalya, K.M., Digital Control, John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, 2007.
Houpis, C. H., Lamont, G. B., Theory, Hardware, Software, McGraw-Hill, New York, 1985.
Leigh, J. R., Applied Digital Control: Theory, Design and Implementation, Prentice Hall,New Jersey, 1985.
Vanlandingham, H. F., Introduction to Digital Control Systems, Macmillan P. C., New York, 1985.
Kuo, B. C., Digital Control Systems, Holt, Rinehart and Winston, inc., New York, 1980.

Advanced Fracture Mechanics

ID: PhD-3361
teaching professor: Sedmak S. Aleksandar
ECTS credits: 5

goals

Course objectives are for the students to understand the basic principles of fracture mechanics theory. Introducing students to the application of fracture mechanics in the analysis of various engineering problems. Introducing students with analytical and experimental methods for the determination of fracture mechanics parameters. Introduce students to the possibilities of numerical methods application to problems of fracture mechanics. Introducing students to the application of finite element method in the analysis of nonlinear problems. Understanding and studying the problems of coupled external loads on welded structures. The development of an independent and practical work using licensed software. Analysis of damage and fracture mechanics using finite element method. The potential co-operation with experts in the field of materials science, which provides the ability to work in specialized laboratories.

learning outcomes

By attending this course students will master the basic principles in the field of fracture mechanics. Theoretical considerations and computational examples enable student to master all the necessary principles and standards in the field of fracture toughness tests of materials. Students master the methods of theoretical analysis and correlation of elsatoplastic fracture mechanics, microstructural investigations and constitutive expression of continuum mechanics, in order to avoid fracture in metallic materials and their compounds. Introducing students to the existing modern standards and recommendations in the given field, using experimental tests.By attending this course the student will master advanced application of finite element method, especially in the field of welding and welded structures. The importance of the application of computational fracture mechanics to structures when there is already noted one or more of the initial cracks. Students are trained to use computational methods to determine whether the stress fields on the constructions will lead to further growth of the crack, and whether crack will be stable or unstable, and based on that can determine the remaining life of the structure.

theoretical teaching

Basic assumptions of elastic-plastic fracture mechanics of materials. Main subject of investigation in fracture mechanics. Classification of fractures. Fracture mechanics parameters of engineering materials. Stress field at the crack tip. Analysis of the brittle fracture problem. Stress intensity factor. Fracture toughness- critical value for stress intensity factor.Crack tip opening. J - contour integral. J integral as a parameter for stress and deformation fields. Nonlinear energy release rate. The connection between the J integral and CTOD. The zone of final stretch. Local access to metallic materials fracture. Local approach in the analysis of crack formation and ductile fracture. Analytical determination of stress intensity factors. Analytical determination of the crack opening and the J integral . REI model. King's model. Experimental determination of fracture mechanics parameters. Numerical determination of fracture mechanics parameters. Solving nonlinear problems using the FEM; types of nonlinearities, a review. Introduction to nonlinearity of the materials, the basics of the theory of plasticity. Presentation of the different criteria of plastic flow of materials in the FEM. The influence of building up the material. The influence of material anisotropy. The problem of heterogeneous materials - application on the welded joints. Problems of the material porosity. Viscoplasticity. Algorithms for solving nonlinear problems; incremental - iterative procedures. Nonlinearity of geometry; analysis of large deformations.Finite element fracture analysis.Numerical analysis in the local approach. The extended finite element method.

practical teaching

Application of fracture mechanics standards. The application of the J integral on crack growth analysis. Empirical formula for the CTOD. EFAM ETM97. EPRI engineering procedures. Experimental determination of fracture mechanics parameters. Determination of fracture toughness. Determination of the critical crack tip opening. Experimental determination of J integral - standard procedure. Measuring the strength of the final zone. Experimental methods for determining the microstructural properties of metallic materials. Numerical methods for determining fracture mechanics parameters. Recommendations of the European Association for Structural Integrity (ESIS).Determination of fracture mechanics parameters in elastic and elastic-plastic field.Application of various algorithms in solving nonlinear problems; the accuracy and convergence of the solutions. Examples of FEM formulation of nonlinearities of geometry. Development of FEM contact models. FEM formulation of dynamic and impact loadings. Post-processing. Techniques of introducing residual stresses - application on different welding procedures. FEM solutions in assessing fracture integrity of the weld. Examples of calculating J-integral for welded joints. Numerical determination of stress intensity factors in the real structure. Numerical simulation of crack propagation using XFEM.

prerequisite

learning resources

1] Written lessons from lectures (handouts)
[2] A. Sedmak, Use of the fracture mechanics on the structure integrity assessment, Faculty of Mechanical Engineering, Belgrade, 2003.
[3] T.L. Anderson, Fracture Mechanics: Fundamentals and Applications, 3rd ed, CRC Press, London, 2005.
[4] Kojic M., Computational Prrocedures in Inelastic Analysis of Solids and Structures, Kragujevac, 1997.

number of hours

lectures: 35
research: 0

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): 40

references

T.L. Anderson, Fracture Mechanics: Fundamentals and Applications 3rd ed. CRC Press, London, 2005.
Jin Z. H., Sun C.T., Fracture Mechanics, Academic Press, 2011.
G. Pluvinage, Fracture and Fatigue Emanating from Stress Concentrators, Springer, Dordrecht, 2004.
J. N. Reddy, An Introduction to the Finite Element Method (Engineering Series), 2005.
Mohammadi S., Extended finite element method for fracture analysis of structure, Blackwell Publishing Ltd.,

Advanced Gas Dynamics

ID: PhD-3365
teaching professor: Stefanović A. Zoran
ECTS credits: 5

goals

This course introduces the concepts of the primary differences between an incompressible flow and compressible flow. It draws the connection between compressible flow and speed of sound, Mach Number and thermodynamics. It then builds on the governing equations to derive the commonly known equations and tackles both 2D and 3D problems.

learning outcomes

Upon completion and passing the Course the student expected to understand the basic characteristics of compressible flows including: wave and wave propagation; analyze isentropic compressible flows as well as effects of friction and heat transfer; analyze normal shock, oblique shock and Prandtl-Meyer flows; learn the development of thermodynamic and flow relationships and apply these to practical problems; become familiar with application-type problems in gas dynamics.

theoretical teaching

One-dimensional unsteady flows, including analysis of unsteady interactions in time-distance and pressure-velocity planes; plane shock waves; steady two-dimensional flows, including subsonic similarity rules, supersonic turning processes, method of characteristics, oblique and bow shocks; a related topic chosen by the class.

practical teaching

Practical part of Course demonstrate the numerical examples in all ranges of high speeds. Practical work of students is realized through a virtual classroom available 24 hours (program MOODLE). In the workshop students have approach to the professor's written notes, lectures and tests for practice. Each student works and study problems individually.

prerequisite

none

learning resources

This Course has a virtual classroom on the Internet. At the first lecture students are enrolled and trained for work (Moodle software). In the workshop approach is performed with the lectures and exercises, guidelines for project design, internet resources, etc.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Zoran Stefanović, Zlatko Petrović . Handouts for Advanced Gas Dynamics, Faculty of Mechanical Engineering, 2012.
Ascher H. Shapiro: Dynamics and Thermodynamics of Compressible Fluid Flow (volumes I and II), Ronald,1995
J.John, T.Keit: Gas Dynamics, Pearson Hall, 2006

Advanced IC Engines simulation

ID: PhD-3287
teaching professor: Tomić V. Miroljub
ECTS credits: 5

goals

Acquiring new knowledge on role and importance of modelling dynamic processes in IC Engines. Broadening theoretical knowledge and analytical approach to thermodynamics, heat and mass transfer, fluid mechanics and fuel combustion by studying dynamic processes in IC Engine cylinder and collectors. Broadening knowledge and skills in applied computational methods and modular programming. Developing practical skills to design complex model structures and apply extensive and efficient numerical methods for studying and research of IC Engine dynamic processes.

learning outcomes

Understanding the reality and complexity of Heat Engines working cycles. Capabilities to design complex models and sub-models structures using multidisciplinary approach. Capabilities to analyse engine processes and performance using advanced simulation models. Establishing the Cause & Effect relationship between working cycle and engine performance.

theoretical teaching

1.Importance of mathematical modeling and computer simulation of engine working process for engine design optimization and improving of engine performances, energetic and ecological characteristics.
2. Basic differential equations of so called "zero-dimensional" model of real working cycle for engine cylinder as open thermodynamical system based on first and second lows of thermodynamic and low of mass conservation.
3. Modeling of gas flow through the restriction points (intake and exhaust valves, crevices) based on isentropic flow of compressible fluid. Analytical and experimental determination of flow coefficients.
4. Modeling of heat transfer to cylinder walls. Theoretical fundamentals and practical equations for the evaluation of heat transfer coefficient.
5. Modeling of engine combustion process (heat release). Types of engine heat release models. The model engine heat release based one stage and two stage Wiebe functions and the correlation of Viebe function parameters with engine type and engine speed and load. "Quasi-dimensional" models of engine heat release:
model of turbulent flame front propagation for spark ignition engines; model of multi-zone combustion in fuel spray for diesel engines "model Hiroyasu".
6. Specific problems of numerical solutions of model differential equations.
7. Experimental testing of engine working process: recording of in-cylinder pressure history; identification of model non sufficient known parameters; verification of cycle simulation results based on experimental results.

practical teaching

1. Cylinder model structure development – Demonstration and Analysis of different models
2. Properties of the working fluid – Demonstration and comparative analysis, empirical models and chemical equilibrium
3. Wiebe single & multi-stage parametric combustion model, flame propagation models, Hiroyasu model
4. Heat transfer models – Demonstration and comparative analysis of different models

5. Gas dynamics – Model structure development, analysis and demonstration using commercial software packages
6. Student project task –SI/CI IC engine simulation model development
7. Laboratory Task: - In-cylinder pressure measurement and combustion analysis

prerequisite

Passed exam in Numerical methods. Good practical knowledge of Matlab/Simulink

learning resources

Mathworks Matlab/Simulink IDE (Licenced)
Ricardo WAVE – 1D Engine and gas dynamics simulation software package (Licenced)
LMS Imagine.Lab AMESim – Simulation software for modelling and analysis of 1D systems (Licenced)
Laboratories equipped with IC Engine testing equipement (fully equiped IC Engine test benches)
DAQ Measurement equipement (National Instruments PXI based system with Labview Developement software)

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0; test/colloquium: 0; laboratory exercises: 10; calculation tasks: 0; seminar works: 80; project design: 0; final exam: 10; requirements to take the exam (number of points): 50

references

J. Heywood: Internal combustion engines fundamentals, McGraw-Hill 1988, ISBN 9780-070-28637-5
F. Pischinger: Verbrennungskraftmaschinen Thermodynamic, Springer Verlag, ISBN
G. P. Merker et. al.: Simulating combustion and pollutant formation for engine development, Springer Verlag, ISBN 10 3-540-25161-8, 13 978-3-540-25161-3
R. Benson: The Thermodynamics and Gas Dynamics of Internal Combustion Engines, Vol 1, Vol. 2, Clarendon Press, Oxford, 1982, ISBN 0-19-856210-1
R Jankov: Diesel engine gas-thermodynamic processes and performance modelling (in Serbian), Naučna knjiga, Beograd, 1984

Advanced Manufacturing Systems

ID: PhD-3364
teaching professor: Miljković Đ. Zoran
ECTS credits: 5

goals

The aim of the course is to provide a framework and specific methods and tools for the selection and configuration of the capacity of Advanced Manufacturing Systems (AMSs). Course includes the ideal guide for a designer who wants to avoid the most common mistakes while consistently maximizing the accuracy and performance of next-generation manufacturing systems. The decision making framework and tools illustrated in this course combine decision-making theory, optimization theory, discrete event simulation and the system of neural networks implementation.
The specific goals of this course follow:
• To show PhD students how to create valid and realistic intelligent manufacturing;
• To study a practical guide to next-generation manufacturing systems;
• To give PhD students insight into decision models of capacity planning problem (type, configuration, resources, etc.).

learning outcomes

The course Advanced Manufacturing Systems covers all the basic concepts in accordance with new methods based on AI techniques and explains how to create and manage the capacity planning, and complete the planned process using finishing and final assembly techniques as well as material transport within the plant.

theoretical teaching

The course Advanced Manufacturing Systems presents new methods and approaches for understanding the world of next-generation manufacturing, where every aspect of intelligent agents must be highly responsive to production designer needs in the 21st century.
The main topics of the course contain the decision models in domain of the capacity planning problem, from the decision on the type of manufacturing systems to adopt to their detailed configuration in terms of resources (machine tools, mobile robots, buffers, etc.).
Main topics of the course are:
* Advanced Manufacturing Systems (AMSs) - Role and Scope.
* A Framework for Long Term Capacity Decisions in AMSs.
* Configuration of AMSs.
* Selecting Capacity Plan.
* Mobile Robots in AMSs - Locomotion, Kinematics, Transport, etc.

practical teaching

Other relevant practical topics covered include mobile robots implementation in AMSs:
* Mobile Robot Perception; Laboratory work.
* Mobile Robot Localization in AMSs; Laboratory work.
* Mobile Robot - Planning & Navigation; Laboratory work.
* Mobile Robot - Handling and Indoor transportation; Laboratory work.

prerequisite

MSc degree of technically oriented faculty.

learning resources

[1] Software packages (BPnet, ART Simulator, Matlab, AnyLogic, Flexy), Laboratory CeNT, University of Belgrade, Faculty of Mechanical Engineering, 18.13
[2] Laboratory mobile robot prototype (Khepera II, LEGO Mindstorm NXT), Laboratory CeNT, University of Belgrade, Faculty of Mechanical Engineering, 18.12
[3] Laboratory model of designed manufacturing system, Laboratory CeNT, University of Belgrade, Faculty of Mechanical Engineering, 18.12

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Andrea Matta, Quirico Semeraro, (editors), (2005) DESIGN OF ADVANCED MANUFACTURING SYSTEMS, Springer.
Roland Siegwart, Illah R. Nourbakhsh, (2004) INTRODUCTION TO AUTONOMOUS MOBILE ROBOTS, a Bradford Book, the MIT Press.
R. R. Murphy, (2000) INTRODUCTION TO AI ROBOTICS, A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England.
M.P. Groover, (2001) AUTOMATION, PRODUCTION SYSTEMS, AND COMPUTER-INTEGRATED MANUFACTURING, 2nd Edition, Prentice Hall.
W. Van de Velde (editor), (1993) TOWARD LEARNING ROBOTS, MIT Press, Special Issues of Robotics and Autonomous Systems, 1993.

Advanced Methods for Maintenance of Railway Vehicles

ID: PhD-3139
teaching professor: Lučanin J. Vojkan
ECTS credits: 5

goals

The aim of the course is to introduce students with specific problems in the maintenance of rolling stock and facilitate the acquisition of knowledge necessary to make the work in this field. Upon completion of the course it is expected that the student will be able to identify and analyze specific problems in the field of maintenance and will be able to serve the mathematical formulas and models in finding appropriate solutions.

learning outcomes

The aim of the course is to introduce students with specific problems in the maintenance of rolling stock and facilitate the acquisition of knowledge necessary to make the work in this field. Upon completion of the course it is expected that the student will be able to identify and analyze specific problems in the field of maintenance and will be able to serve the mathematical formulas and models in finding appropriate solutions.

theoretical teaching

Systems approach to the maintenance of rail vehicles. Maintenance and life cycle. Maintenance process. Maintenance systems. Systems maintenance of rail vehicles(maintenance Serbian Railway, applied systems of maintenance of railway vehicles in the world). Integrated logistics and technical security of rail vehicles. Analysis and evaluation of system maintenance. Management of spare parts. Information systems maintenance.

practical teaching

Nothing

prerequisite

Finished course in statistics field in previous studies.

learning resources

Literature that is available in the Faculty Bookstore and Library; Handouts available on lectures; Internet resources (KOBSON).

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 100; requirements to take the exam (number of points): 0

references

S. Muzdeka, Logistics, Script, Institute of Nuclear Science "Boris Kidric", Vinca, 1981.
N. Vujanovic, Theory of reliability of technical systems, Belgrade, 1990.
J. Todorovic, Engineering of maintenance of technical systems , JUMB, Belgrade, 1993.

Advanced Nanotechnology

ID: PhD-3115
teaching professor: Koruga LJ. Đuro
ECTS credits: 5

goals

The main objective of this course is to introduce students in a modern nanotechnology, modifications and manipulations at the atomic and nano level. They will be able to understand how can get intelligent materials using nanotechnology solutions. Also, they will acquire knowledge of mechatronics at the nano scale. The students will gain knowledge to understand the principles of AFM-based magnetic resonance and spin measurements.

learning outcomes

The students will be able to use NanoProbe in vacuum conditions, under the pressure and diferent temperatures. They will be trained for atoms manipulation as well as for creation of nano-forms with desired properties. The knowledge to measure the effects of spin before and after the exposure of materials to static and oscillatory magnetic field will be gained.

theoretical teaching

The basics nano-mechanics and nano-electronics will be studied as well as the principles of mechatronics at the nano level. The part of the course will be dedicated to the molecular nano magnets. In addition, a coding intelligent and nanomaterials will be taught. Operating procedures with probes of nanotubes will be studied. Procedures for using the device for modification NanoProbe structure at nanoscale will be introduced.

practical teaching

The training to work with the device with static and dynamic magnetic field will be provided as well as with the MFM module NanoProbe device. Work on NanoProbe device in a vacuum, pressure and temperature will be also part of the training. In addition, the students will be traind for atom-by-atom manipulation, nanolithography and surface modification of thin films. Measuring the effects of spin material exposed to static and oscillatory magnetic field will be taught.

prerequisite

To be enrolled in doctoral studies.

learning resources

1. NanoProbe device module MFM (JEOL, JSPM-5200, Japan)
2. JEE-420 vacuum evaporator for thin films obtaining

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

(number of points): 0

references

Srinivasan, A.V., Smart Structures: Analysis and design, Cambridge University Press, Cambridge, 2001
Avouris, P., Atomic and Nanometer-Scale Modification of Materials, Kluwer Academic Pub. Dordrecht, 1993
Gatteschi, D., Molecular nanomagnets, Oxford University Press, Oxford, 2006
Lyshevski, E.S., Nano and Molecular Electronics (Handbook), CRC Press, Boca Ratom, 2007
Hanson, G.W., Fundamentals of nanoelectronics, Pearson/Prentice Hall, 2008.

Advanced Numerical Methods

ID: PhD-3338
teaching professor: Petrović I. Zlatko
ECTS credits: 5

goals

Educate students to solve and understand solution process of applied partial differential equations connected to engineering problems.

learning outcomes

Ability to reckognize solution procedure and additional conditions for solutions of typical engineering problems expressed through partial differential equations.

theoretical teaching

Introduction to engineering simulations, Analytic solutions of partial differential equations, Finite difference method, Parabollic partial differential equations, Non linear parabolic partial differential equations, Stability analysis, Elliptic partial differential equations, Conjugent gradient method, Multigrid method, Hiperbolic partial differential equations.

practical teaching

Each theoretical topic is illustrated with multiple examples wich illustrate solution procedure and the procedure of the presentation of results.

prerequisite

No preconditions.

learning resources

Computer laboratory, laptop, projector.

number of hours

lectures: 35
research: 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: 60; final exam: 30; requirements to take the exam (number of points): 40

references

Z. Petrovic, S. Stupar, "CFD-ONE", Univerzitet u Beogradu, Beograd 1992
Lecture Slides and handouts.

Advanced robotics-selected chapters

ID: PhD-3127
teaching professor: Lazarević P. Mihailo
ECTS credits: 5

goals

Introduce students to basic concepts of kinematics and dynamics of advanced robotic systems. It is possible to solve kinematics and dynamics tasks as well as control task of the robot system (RS)-(redundant RS,obstacle avoidance,task planning and navigation,robot vision) based on applications of intelligent methods of control as well as using modern theory based on Rodriguez transformation matrix,quaternions as well as the theory of finite rotations. Determination (simulation) models of RS - i.e. differential equations of motion of the RS, which are important in practical problems of the RS.Practical simulations RS using MATLAB,Cyberbotics Webots software package and students work with laboratory robot NEUROARM.

learning outcomes

By attending this course student acquires the ability to analyze problems and synthesis solutions to the problem of kinematics and dynamics of robotic systems using scientific methods and procedures as well as computer technology and equipment. This enabled him applying solutions to practical problems of robotic systems as well as monitoring and implementation of innovation in the development of new robotic systems.

theoretical teaching

Basic concepts and specifications of advanced robotic system (RS). Rodriguez formula and the transformation matrix (MT). Determining of kinematic parameters of RS. Direct and inverse kinematics of robot task- characteristic cases. Fundamentals of quaternion theory and theory of finite rotations.
Differential equations (DIFE)of motion of RS applying Rodrigues approach and quaternions: typical cases- in the form of kinematic chain with the structure of topological three,in the form of closed-kinematic chain. Equations of motion of RS with Langrange multipliers. Kane's equations of motions of RS.Redundant RS. Fundamentals of advanced control algorithms of RS as well as remote control RS. Applications of control of RS based on fractional calculus. Fundamentals of robot programming languages.
Solving typical tasks of advanced robotic systems: resolving redundant problem, obstacle avoidance,task planning and navigation,robot vision.
A example of biologically inspired intelligent robot.

practical teaching

Examples of determining the number of degrees of motion of the RS; Calculation the Rodriguez transformation matrix(MT)-typical cases,determination of kinematic characteristics of the RS in MATLAB environment. Solving the direct and inverse kinematic task of RS. Solving the direct and inverse dynamics task of the RS in MATLAB environment. Examples of DIFE of RS simulation in MATLAB-GUI, MATHEMATICA environment, an example of a redundant RS. An example of simulation RS using Cyberbotics Webots package. Example of control of the RS-laboratory robot NeuroArm with 7 degrees of freedom in the MATLAB environment. A example of video-servo control of RS.Simulation and control of LEGO Mindstorms robots.

prerequisite

none

learning resources

1.Čović M. V. Lazarević, Mechanics of Robot, MF Belgrade,2009.(Book)
2.Lazarević M. Exercises in mechanics of robot, MF Belgrade,2006.(ZZD)
3.Wittenburg J., Dynamics of Systems of Rigid Bodies, Teubner, Stuttgart, 1977. (XJ)
4.Craig J., Introduction to Robotics, Mechanics and Control, Addison-Wesley, 1989.
5.Written abstracts from the lectures (Handouts)
6.Cyberbotics Webots - software package
7.NeuroArm-laboratory robot with 7 degrees of freedom.
8.MATLAB,MATHEMATICA-mathematics software packages
9.Kuipers, J.B.: Quaternions and Rotation Sequences: A Primer with Applications to Orbits,Aerospace and Virtual Reality, Princeton University Press, New Jersey, 1999.
10. Craig Sayers,Remote Control Robotics,Springer,1998.
11.C. A. Monje, YQ. Chen, B. M. Vinagre, D. Xue, V. Feliu, Fractiona Order Systems and Controls – Fundamentals and Applications, Springer, 2010

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

Bruno Siciliano, Oussama Khatib, Springer Handbook of Robotics,Springer-Verlag Berlin Heidelberg 2008.
Thomas R. Kurfess.,Robotics and automation handbook,CRC Press LLC, Boca Raton, Florida,2005
Ahmed A. Shabana, Dynamics of Multibody Systems,Cambridge University Press The Edinburgh Building, Cambridge , UK,2005.
M.W. Spong, M. Vidyasagar: Robot Dynamics and Control (Wiley, New York 1989)
Yoseph Bar-Cohen, Cynthia L. Breazea,Biologically Inspired Intelligent Robots ,SPIE org,2003

Advanced techniques in IC Engine testing

ID: PhD-3289
teaching professor: Tomić V. Miroljub
ECTS credits: 5

goals

The goal of this course is to provide a student with the comprehensive knowledge in the field of measurements and data analysis specific for the most demanding IC engines testing techniques - those related to engine working process analisys, emmision and dynamic behaviour of its components.

learning outcomes

Integration of knowledge on thermodynamics of an engine working process, heat and mass transfer, flows and state of the art measurements techniques and measuring chains for IC Engine indicating, exhaust emission measurement and engine dynamics measurement. PhD student trained for conducting and organising a research in the IC engine testing lab.

theoretical teaching

- The importance of in-cylinder pressure measurement (indication in general)
- Building pressure sensor and measuring chain
- Thermodynamic relationships of engine working cycle parameters
- Determining the piston TDC position
- Data pretreatment, processing and analysis
- Zero-point correction of the measurement data
- Determination of residual gas proportion
- Rapid evaluation methods
- In-cylinder pressure indicating coupling with other rapid methods of measurement
- Crankshaft instantenous speed and acceleration measurements - torsional vibration analysis

practical teaching

IC Engine test lab practice covering tasks incorporating in-cylinder pressure indicating , data processing and analysis; Practice on crankshaft torsional vibration measurement and data analysis; Practice with the Exhaust Emission test bench (NDIR, FID, Paramagnetic, Partial flow dilution tunnel,...);

prerequisite

No particular requirements for attending this course

learning resources

Mathworks Matlab/Simulink IDE (Licensed)
Ricardo WAVE – 1D Engine and gas dynamics simulation software package (Licensed)
LMS Imagine.Lab AMESim – Simulation software for modelling and analysis of 1-D systems (Licensed)
Laboratories equipped with IC Engine testing equipment (fully equipпed IC Engine test benches)
DAQ Measurement equipment (National Instruments PXI based system with LabView Development software)

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0; test/colloquium: 0; laboratory exercises: 10; calculation tasks: 0; seminar works: 80; project design: 0; final exam: 10; requirements to take the exam (number of points): 80

references

Manz: Indiziertechnik an Verbrennungsmotoren, TU Braunschweig
Kuratle, R.,Motoren-Meßtechnik,Vogelverlag 1995
Fernando Puente León, Uwe Kiencke:Messtechnik: Systemtheorie für Ingenieure und Informatiker, Springer, 2011
Plint, M., Martyr, A.: Engine testing - Theory and practice, Butterworth-Heinemann, Oxford, 1997. ISBN 0-7506-1668-7.

Advanced Thermal Power Cycles

ID: PhD-3209
teaching professor: Petrović V. Milan
ECTS credits: 5

goals

1. The achievement of research and expert competence in the field of advance cycles in thermal power engineering.
2. The achievement of high level of theoretical knowledge
3. The acquisition of research and expert knowledge to optimize thermodynamic cycle (steam turbines cycles, gas turbine cycles, combined cycles).
4. The achievement of the techniques of process modeling.
5. Mastering the methods of experimental work in thermal power engineering.

learning outcomes

1. Expert and research deep knowledge of the thermodynamic cycle in thermal power engineering
2. The development of critical thinking about energy use, fuel efficiency and environmental preservation
3. The ability of calculate heat balance diagrams and main parameters of the steam turbine power plants.
4. Ability to use computer technology for modeling and calculations

theoretical teaching

Steam turbines cycles. Cycles with ultra super critical parameters. Complex steam turbine cycles. Advance gas turbine cycles. Complex gas turbine cycles. Cycles with turbine cooling. Combined gas turbine/steam turbine cycles. Cycle optimization. Parameters selection. Cycle configuration selection. Cost/benefit analysis of thermal power plant. Energy and exergy analysis. Optimization of power plant operation.

practical teaching

Development of method and computers code for design and optimization of thermal power cycles.

prerequisite

learning resources

Literature, computing facility, software

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Petrovic, M.: Steam turbines, script, 2004.
Stojanovic, Themal Turbomachinery, Gradjevinska knjiga, Belgrade, 1967.
A.Bejan, G. Tsatsaronis, M. Moran: Thermal Design and Optimization, Wiley, 1996.
Traupel,W.: Thermische Turbomaschinen, Springer verlag, Berlin, 1982
Cohen, H., Rogers,G.F.C., Saravanamuttoo, H.I.H.: Gas turbine theory, Logman, 1997.

Advanced Topics in Actuating Systems

ID: PhD-3352
teaching professor: Miloš V. Marko
ECTS credits: 5

goals

To qualify students to perform complex modeling and simulation of various types of actuating systems independently.

learning outcomes

Students will gain knowledge that will qualify them for laying-out (designing).

theoretical teaching

1. Advanced design algorithms
2. Sensors
3. Digital measuring systems
4. Improved Methods for selection of the components
5. Contol requirements, control system & stability
6. Mathematical modeling
7. Simulations

practical teaching

Modeling and simulation of complex actuating systems.
After completion of the modeling and simulation, practical work with different actuating systems.
Also, visiting to Department of Automatic Control of Faculty of Mechanical Engineering.

prerequisite

Using of MATLAB® i Simulink®.
Using of 3D CAD design software (any).

learning resources

Moodle (Modular Object-Oriented Dynamic Learning Environment , a free, open-source PHP web application for producing modular internet-based courses that support a modern social constructionist pedagogy).
Lectures, power point presentations, romm equipped with computers & software for design and simulations, labs, handouts.

number of hours

lectures: 35
research: 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: 0; project design: 100; final exam: 0; requirements to take the exam (number of points): 0

references

M.Milos, Advanced Topics in Actuating Systems, professor's handouts
E. Doeblin, Measurement Systes, Application and Design – McGraww-Hill
A. VanDoren, Data Acquisition Systems, Reston Publishing Co., Inc.
N. Avgoustinov: Modelling in Mechanical Engineering and Mechatronics – Springer, 2007
W. Bolton: Mechatronics-Electronic Control Systems in Mechanical and Electrical Engineering – Pearson, 2012

Advance in Chemical Process Equipment

ID: PhD-3222
teaching professor: Radić B. Dejan
ECTS credits: 5

goals

Mastering the method of modeling, development and design of chemical reactors and operations

learning outcomes

Getting to know the candidates with the problem and how to solve the problems of designing various types of chemical reactors that operate in different conditions. Introduction with types of chemical reactors. Setting up of mathematical models that can describe the processes in chemical reactors. Outcome: mastering the methodology of calculation of chemical reactors and chemical processes.

theoretical teaching

Basic types of chemical reactors. Models of chemical reactors. Theoretical basis. Analysis of chemical reactors of periodical and continuous flow. Equipment and design of chemical reactors. Coupling of chemical reactors. Measurement and control of process in chemical reactors. Material and energy balance of chemical reactions and chemical reactors. Chemical kinetics. Design of isothermal processes in chemical reactors. Design of nonisothermal processes in chemical reactors. Thermodynamics analysis of precesses in chemical reactors. Analytical and numerical problem solving of design of chemical reactors. Optimization of processes in chemical reactors.

practical teaching

Students work under the supervision of teacher one seminar paper that needs student to apply knowledge.
If needed laboratory work and visits to industrial facilities.

prerequisite

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learning resources

Laboratory and computational equipment.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Coulson, J. M., Richardson, J. F.: Chemical Engineering, Vol. 3: Chemical Reactor Design, Biochemical Reaction Engineering including Computational Techniques and Control, Pergamon Press, Oxford, 1982.
Smith, J.M., Van Ness, H.C., Addott, M.M.: Chemical Engineering Thermodinamics, McGraw International Edition, ISBN: 0-07-240296-2, 2001.
Belfiore, L.A.: Transport phenomena for Chemical Reactor Design, Wiley, New Jersey, ISBN: 0-471-20275-4, 2003.
Levenspiel, O.: Chemical reaction engineering (Serbian edition), Faculty of Technology and Mettalurgy, Belgrade, 1991.
Perry's Chemical Engineering Handbook, Mc-Graw Hill, 1999.

Advances in drying processes and research

ID: PhD-3100
teaching professor: Jovović M. Aleksandar
ECTS credits: 5

goals

The aim of this course is introducing the candidates with problems and problem solving of drying, evaporation and wetting with appropriate scientific methods, subject is designed as an advanced course in the given area at level of doctoral studies.

learning outcomes

At the end of the course it is expected that the candidate has mastered the scientific knowledge pertaining to the analysis and evaluation of scientific papers, ways and methods of analysis of individual processes, laboratory work, as well as advanced process modeling in the area of the drying process, heat and mass transport in these processes and etc..

theoretical teaching

The classification of processes of moisture extraction. Convective drying. Potential theory. Vapor-material equilibrium. The transfer of moisture in capillary-porous bodies. The analytic theory of heat and mass diffusion. Heat and material balance. Convective dryer. Conductive drying. Drying in a fluidized bed. Radiation drying. Injection drying. Sublimation drying. Selection of the optimum conditions of the processes. Wetting processes. The coefficient of heat transfer with phase change. Triple analogy. Cooling towers. Processes modeling in order to determine the dynamic parameters and manageability of the system.

practical teaching

Laboratory work if needed or research at industrial installations.

prerequisite

There is no previous requirements for attending this course.

learning resources

Laboratory installation and measuring equipment if needed, measuring equipment for research at industrial installations.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 5; calculation tasks: 0; seminar works: 90; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Treybal, R.E., Mass-Transfer Operations, McGraw-Hill, New York, 1981
Foust, A.S., i dr., Principles of Unit Operations, John Wiley & Sons, New York, 1980.
Coulson, J.M., Richardson, J.F., Chemical Engineering, vol. 2, Butterworth-Heinemann, 2002., ISBN 0 7506 4445 1
Keey, R.B., Drying Principles and Practice, Perganon, Press, London, 1972
Papers from journals Drying, Journal of Colloid and Interface Science, Chemical Engineering Progress, Chemosphere i sl.

Advance techniques in IC engines – selected topics

ID: PhD-3288
teaching professor: Tomić V. Miroljub
ECTS credits: 5

goals

Acquiring new knowledge on role and importance of modelling dynamic processes in IC Engines. Broadening theoretical knowledge and analytical approach to thermodynamics, heat and mass transfer, fluid mechanics and fuel combustion by studying dynamic processes in IC Engine cylinder and collectors. Broadening knowledge and skills in applied computational methods and modular programming. Developing practical skills to design complex model structures and apply extensive and efficient numerical methods for studying and research of IC Engine dynamic processes.

learning outcomes

Understanding the reality and complexity of Heat Engines working cycles. Capabilities to design complex models and sub-models structures using multidisciplinary approach. Capabilities to analyse engine processes and performance using advanced simulation models. Establishing the Cause & Effect relationship between working cycle and engine performance.

theoretical teaching

1. Selected topics in Engine exhaust and noise emission. Exhaust gas concentration modelling based on chemical reactions kinetics and chemical equilibrium. Exhaust gas emission measurement.
2. Gas flow in intake and exhaust ports and collectors. 1-D modelling of dynamic gas flow in pipes. Optimization of Intake and exhaust plenum geometry by maximizing engine volumetric efficiency.
3. Mechanical losses in IC engines. Modelling engine friction and auxillaries power consumption. Experimental determination of mechanical losses distribution.
4. In-cylinder and port flow multidimensional modelling using CFD. The characterization of gas velocity profile in engine cylinders and ports by application of advanced anemometry measurement methods.

practical teaching

1. Chemical reactions kinetics and chemical equilibrium - Governing Equations and numerical solution. Laboratory test - IC engine exhaust emission measurement in steady state and transient operation conditions. Project task: Combustion product composition modelling based on assumption of chemical equilibrium

2. 1-D gas dynamics – Model governing equations and structure development, analysis and demonstration using commercial software packages. Solution methods and boundary conditions (comparative analysis of constant pressure charging, Fill and Empty technique, Wave-Action Method). Project task: Development, tuning and application of 1-D model of gas flow in IC engine collectors and ports.

3. Engine mechanical losses modelling - Global models. Detailed empirical and analytic angle resolved dynamic models. Prediction of engine performance by means of combined modelling of engine combustion and mechanical losses. Laboratory task: Measurement of friction losses in engine cylinder-piston assembly and bearings. Project task: Development, tuning and application of an engine friction model.

4. In-cylinder and port flow multidimensional modelling using CFD. Gas flow in complex geometry combustion chamber - simulation example. Laboratory task: Flow field characterization in engine ports and combustion chambers. Project task: Multidimensional model of gas flow in engine plenums and ports - model development in CFD software package and its application.

prerequisite

Passed exam in Numerical methods and Advanced topics in IC engine simulation. Good practical knowledge of Matlab/Simulink

learning resources

Mathworks Matlab/Simulink IDE (Licensed)
Ricardo WAVE – 1D Engine and gas dynamics simulation software package (Licensed)
LMS Imagine.Lab AMESim – Simulation software for modelling and analysis of 1-D systems (Licensed)
Laboratories equipped with IC Engine testing equipment (fully equipпed IC Engine test benches)
DAQ Measurement equipment (National Instruments PXI based system with LabView Development software)

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0; test/colloquium: 0; laboratory exercises: 10; calculation tasks: 0; seminar works: 0; project design: 80; final exam: 10; requirements to take the exam (number of points): 0

references

J. Heywood: Internal combustion engines fundamentals, McGraw-Hill 1988, ISBN 9780-070-28637-5
F. Pischinger: Verbrennungskraftmaschinen Thermodynamic, Springer Verlag, ISBN 978-3211836798
G. P. Merker et. al.: Simulating combustion and pollutant formation for engine development, Springer Verlag, ISBN 10 3-540-25161-8, 13 978-3-540-25161-3
R. Benson: The Thermodynamics and Gas Dynamics of Internal Combustion Engines, Vol 1, Vol. 2, Clarendon Press, Oxford, 1982, ISBN 0-19-856210-1
G. Stiech: Modeling Engine Spray and Combustion Process, Springer Verlag, ISBN 3-540-00682, 2003

Aerodynamics of Thermal Turbomachinery

ID: PhD-3210
teaching professor: Petrović V. Milan
ECTS credits: 5

goals

1. The achievement of research and expert competence in the field of aerodynamic design of thermal turbomachinery.
2. The achievement of high level of theoretical knowledge
3. The acquisition of research and expert knowledge to optimize design of thermal turbomachinery.
4. The achievement of the techniques of process modeling.
5. Mastering the methods of experimental work in thermal power engineering.

learning outcomes

1. Expert and research deep knowledge in the field of aerodynamic design of thermal turbomachinery.
2. The development of critical thinking about energy use, fuel efficiency and environmental preservation
3. The ability of aerodynamic design of thermal turbomachinery.
4. Ability to use computer technology for modeling and calculations
5. Experimental methods in turbomachinery.

theoretical teaching

Systems of governing equations describing the flow of thermal turbomachines. Approximation in calculations of flow thermal turbomachinery. Loss and deviation models. Models of spanwise mixing and cooling. Models to determine properties of the working fluid. Numerical methods for solving of the system of equations for the flow calculation in thermal turbomachines.Experimanthal methods for mesuremets of flow in thermal turbomachinery.

practical teaching

Development of methodology and software for aerodynamic analysis and design of thermal turbomachinery.
Experimental research.

prerequisite

PhD student - thermal power engineering.

learning resources

Computing facility, laboratory, measuring devices.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Petrovic, M.: Berechnung der Meridionalströmung in mehrstufigen Axialturbinen bei Nenn- und Teillastbetrieb, VDI-Verlag GmbH, Düsseldorf, 1995, 124 Seiten, ISBN 3-18-328007-8
Stojanovic, Themal Turbomachinery, Gradjevinska knjiga, Belgrade, 1967.
Traupel,W.: Thermische Turbomaschinen, Springer verlag, Berlin, 1982
Cumpsty, N.A , Compressor Aerodynamics, 1989 Longman Scientific and Technical, 2004 Krieger, 2004
Lakshninarajana, B: Fluid Dynamics and Heat Transfer of Turbomachinery, Wiley, 1996,

Aerodynamics of Turbocompressors

ID: PhD-3369
teaching professor: Petrović V. Milan
ECTS credits: 5

goals

1. The achievement of research and expert competence in the field of aerodynamics of compressors.
2. The achievement of high level of theoretical knowledge
3. The acquisition of research and expert knowledge aerodynamic design of compressors.
4. The achievement of the techniques of process modeling.
5. Mastering the methods of experimental work in thermal power engineering.

learning outcomes

1. Expert and research deep knowledge of aerodynamics of compressors.
2. The development of critical thinking about energy use, fuel efficiency and environmental preservation
3. The ability of calculate compressors.
4. Ability to use computer technology for modeling and calculations

theoretical teaching

Thermodynamic background of turbocompressors.Processi turbocompressors. Efficiency. Cascades of turbocompressors. Geometric and operating parameters of the cascades. Main aerodynamic cascade parameters. Aerodynamic losses of compressor stages. Deviation model. Mean-line theory of compressor stages. Energy balance of the compressor stage. Design factors of turbocompressors. Dependence of the compression ratio from the operating parameters. 3D flow in normal stages of axial compressors. Optimal design factors. Determination of main dimensions of axial compressors. The behavior of the compressors at variable loads.

practical teaching

Development of methodology and software for aerdynamic design of compressors.

prerequisite

PhD- student -thermal power enegineering

learning resources

Computing facility,literature

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Petrovic, M: gas turbines and Turbocompressors, scrip, 2004.
Stojanovic, Themal Turbomachinery, Gradjevinska knjiga, Belgrade, 1967.
Traupel,W.: Thermische Turbomaschinen, Springer verlag, Berlin, 1982
Cumpsty, N.A , Compressor Aerodynamics, 1989 Longman Scientific and Technical, 2004
Krieger, 2004
Lakshninarajana, B: Fluid Dynamics and Heat Transfer of Turbomachinery, Wiley, 1996,

Aeronautical Safeguarding

ID: PhD-3233
teaching professor: Rašuo P. Boško
ECTS credits: 5

goals

Introducing students to the most advanced methods of logistics support airplanes in the world today. Also, teach students about the elements, such as maintainability, reliability, survivability and others, as constructive data of determining the efficiency of use of airplanes.

learning outcomes

Students will be introduced to the procedure of abstract thinking and creative idea generation, development methodology and the design of new aircraft to the optimal aeronautical safeguarding.

theoretical teaching

The modern concept of aeronautical safeguarding in the world today. Quantitative indicators of reliability and maintainability of aircraft systems. Maintainability prediction methods aviation system. Combat aircraft survivability. Increasing of the combat aircraft survivability. Sensitivity to aircraft damage. Vulnerability of aircraft. Identification of critical components. Levels of destruction of aircraft. Concepts to reduce vulnerability of aircraft.

practical teaching

Factors the availability of elements (equipment): Self (internal) availability, achieved (reached) the availability, application availability, achieved availability. Development of computational tasks in the contents taught, activities in the prediction of maintainability, maintainability of aircraft structures, making computational tasks in the traversed material, Diagnostics - Nondestructive testing methods, modern concept of Aeronautical Safeguarding securing aircraft, combat survivability, vulnerability of aircraft and Consultation.

prerequisite

No special requirements

learning resources

Books, B. Dhillon, MECHANICAL RELIABILITY: THEORY, MODELS AND APPLICATIONS, AIAA Education Series, 1988, 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

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

of points): 40

references

R. Ball, Fundamentals of Aircraft Combat Survivability: Analysis and Design, 2nd Edition, AIAA, 2003.
Alessandro Birolin, Reliability Engineering: Theory and Practice, Springer Verlag, 2007.

Aircraft Production Technology

ID: PhD-3236
teaching professor: Rašuo P. Boško
ECTS credits: 5

goals

Introducing students to the most advanced aviation materials and technological processes that are used in the production of aircraft. Subjects like classic, composite, ceramic, hybrid, intelligent (smart) and functional materials and appropriate technology in the production of modern aircraft.

learning outcomes

Students will be introduced to the procedure of abstract thinking and creative idea generation, technological developments in the methodology of new aircraft that are designed and based on a completely new and modern technological solutions.

theoretical teaching

Modern Aluminium, Nickel, Titanium and Beryllium alloys. Modern composite materials. Thermoplastic and thermoset materials in aviation. Synthetic resins - matrix (binder) materials: epoxy, polyester, vinyl ester-, phenolic, polyimide, etc. bizmaleimidne. Armirajuća fibers: glass, carbon, aramid and pine (Kevlar). Prepreg materials. Modern hybrreinforced. Reinforced materials. Composites based metal matrix. Modern ceramic materials. "Smart" and functional materials in modern aeronautical engineering. Piezoelectric materials, alloys with the possibility of "saving" shape. Intelligent composite actuators. Cellular materials, intelligent optical fibers. Electric, magnetic and semiconductor materials.

practical teaching

Verification, homologation and fatigue testing of aircraft structures that are performинг at the Laboratory Institute of Aeronautical Department, Faculty of Mechanical Engineering, the University of Belgrade.

prerequisite

No special conditions

learning resources

Books: A. A. Baker, Donald Kelly, Stuart Dutton, Alan A. Baker, Composite Materials for Aircraft Structures, 2nd Edition, AIAA, 2004, and Donald J. Leo, Engineering Analysis of Smart Material Systems, John Wiley & Sons, 2007, 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.

Laboratory of Aeronautical Department, Faculty of Mechanical Engineering, the University of Belgrade for verification, homologation and fatigue testing of aircraft structures.

number of hours

lectures: 35
research: 0

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): 40

references

A. A. Baker, Donald Kelly, Stuart Dutton, Alan A. Baker, Composite Materials for Aircraft Structures, 2nd Edition, AIAA, 2004.
Donald J. Leo, Engineering Analysis of Smart Material Systems, John Wiley & Sons, 2007.

Airfoils and Hydrofoils

ID: PhD-3375
teaching professor: Stefanović A. Zoran
ECTS credits: 5

goals

The objectives of this course are to demonstrate and explain several commonly used techniques for designing airfoils and hydrofoils in the subsonic and transonic regimes of speed. Students are trained to understand desirable aerodynamic characteristics, and establish criteria that a properly designed airfoil or hydrofoil should meet.

learning outcomes

Upon completion and passing the Course the student is expected to have independent research, collection the data, standard problem take into analytical the identification acquire conclusion, and have development innovation and compose the ability of professional thesis. Usage mathematics engineering realm is related analysis and design software, explanation data with independently solve the ability of problems.

theoretical teaching

Introductory Remarks; Airfoil section definition and types; Design Specifications; Single Point vs. Multi-Point Design; Steps to a Successful Design; Set of Tools; Airfoil Aerodynamics (Hydrodynamics); Conformal Mapping; Panel Method; Transonic Potential Flow Method; Boundary Layer Analyses; Optimization Method; Airfoil fitting; Surface quality influence; Standard roughness; Problems of high speeds and liquid media; Cavitation

practical teaching

In the practical part of the Course professor demonstrate the numerical examples in various areas of airfoil and hydrofoil applications. Practical work of students is realized through a virtual laboratory available 24 hours (program MOODLE). In the workshop students are available to the professor's written notes, lectures, assignments and tests for practice.

prerequisite

none

learning resources

This course has a virtual classroom on the Internet. At the first lecture students are enrolled and trained for work (Moodle software). In the workshop approach is performed with the lectures and exercises, guidelines for project design, internet resources, quizzes, etc.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Zoran Stefanović, Ivan Kostić : Handouts for Airfoils and Hydrofoils, Faculty of Mechanical Engineering, 2012.
Ira H. Abbott , A. E. von Doenhoff : Theory of Wing Sections, Dover, 1959.
Holt Ashley, Marten Landahl : Aerodynamics of Wings and Bodies, John Wiley & Sons, 1995

Analitical mechanics

ID: PhD-3093
teaching professor: Jeremić M. Olivera
ECTS credits: 5

goals

-to provide students knowledge of the fundamental principles and methods in Analytical Mechanics
-to enable students to solve practical problems in Analytical Mechanics using acquired knowledge in Analytical Mechanics
-to prepare students to monitoring novelties in science and engineering

learning outcomes

-to enable students to master terms, methods and principles in Analytical Mechanics
-to enable students to relate the knowledge from Analytical Mechanics with knowledge in other scientific fields, to apply knowledge from Analytical Mechanics in analysis, synthesis and prediction of solutions and consequences of problems in science

theoretical teaching

Free and constrained mechanical system. Contraints and their classification. Introductory treatise of generalized coordinates. Quasi-velocities and quasi-coordinates. Possible and virtual displacements. Ideally smooth constraints. Differential principles of mechanics and their application in differential equations forming. Lagrange's equations of first and second kind. Energy integral. Cyclic coordinates and cyclic integral. Routh's equations. Function of acceleration and Appell's equations. Integral principles. First and second form of Hamilton's principle. Canonical equations. Lagrange's principle of steady action. Geometrical interpretation of particle's and mechanical system's motion. Hertz's principle of the least curvature.

practical teaching

Free and constrained mechanical system. Contraints and their classification. Introductory treatise of generalized coordinates. Quasi-velocities and quasi-coordinates. Possible and virtual displacements. Ideally smooth constraints. Differential principles of mechanics and their application in differential equations forming. Lagrange's equations of first and second kind. Energy integral. Cyclic coordinates and cyclic integral. Routh's equations. Function of acceleration and Appell's equations. Integral principles. First and second form of Hamilton's principle. Canonical equations. Lagrange's principle of steady action. Geometrical interpretation of particle's and mechanical system's motion. Hertz's principle of the least curvature.

prerequisite

Defined by the curriculum study of Phd studies program.

learning resources

[1] Andjelic T., Stojanovic R.; Rational Mechanics, Belgrade, 1966.
[2] Lurje A.; Analytical Mechanics, Moscow, 1961.
[3] Gantmaher F.; Lessons on Analytical Mechanics, Nauka, Moscow, 1966.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

Anđelić T.; Stojanović R.; Racionalna mehanika, Zavod za izdavanje udžbenika SRS, Beograd, 1966.
Lurje A.; Analitičeskaja mehanika, Moskva, 1961.
Gantmaher F.; Lekciji po analitičeskoj mehanike, Nauka, Moskva, 1966.

Analytical methods for engineering desigh

ID: PhD-3012
teaching professor: Babić R. Bojan
ECTS credits: 5

goals

This course will enable the learner to appreciate that design involves synthesising parameters that will affect the design solution. The learner will prepare a design specification against a customer's specific requirements. They will then prepare a design report that provides an analysis of possible design solutions, an evaluation of costs and an indication of how the proposed design meets the customer's specification. It is expected that the learner will, during the design processes, make full use of appropriate information and communication technology Course aim is to scrutinize the design process in its entirety, from problem definition to conceptualization to embodiment and realization, in a discipline-independent framework, with the purpose of gaining insight into the process from the most general viewpoint.

learning outcomes

On successful completion of this unit a learner will:
1 Be able to prepare a design specification to meet customer requirements
2 Be able to analyse and evaluate possible design solutions and prepare a final design report
3 Understand how computer-based technology is used in the engineering design process.

theoretical teaching

Customer requirements: all relevant details of customer requirements are identified and listed eg aesthetics, functions, performance, sustainability, cost, timing and production parameters; all relevant regulations, standards and guidelines are identified
Design parameters: implications of specification parameters and resource requirements are identified and matched; the level of risk associated with each significant parameter is established
Design information: all relevant information is extracted from appropriate reference sources; techniques and technologies used in similar products or processes are identified; use of new technologies are specified where appropriate; relevant standards and legislation are identified and applied throughout; design specification is checked against customer requirements

practical teaching

Examples of application of analytic design methods. Axiomatic design of products, processes and systems. Application of axiomatic design in manufacturing domain. Defining functional requirements for manufacturing system. Design for manufacturing, design of manufacturing processes and intelligent machines. Intelligent system for design of manufacturing systems. Project and consultations about project. Software packages for axiomatic design. Examples of making designs based on ergonomics. Discussions and workshops.

prerequisite

Defined by curriculum of study programme/module.

learning resources

(1) I-TRIZ Innovation WorkBench – a comprehensive software tool for inventive problem solving.

(2) I-TRIZ Ideation Brainstorming – a simplified tool for solving problems of light to medium complexity.
(3) Axiomatic design software

number of hours

lectures: 35
research: 0

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

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
N. P. Suh, (1990) THE PRINCIPLES OF DESIGN, Oxford University Press, New York
G. J. Park, (2007) ANALYTIC METHODS FOR DESIGN PRACTICE, Springer Verlag, London

Analytic Methods for Engineering Design

ID: PhD-3341
teaching professor: Babić R. Bojan
ECTS credits: 5

goals

This course will enable the learner to appreciate that design involves synthesising parameters that will affect the design solution. The learner will prepare a design specification against a customer's specific requirements. They will then prepare a design report that provides an analysis of possible design solutions, an evaluation of costs and an indication of how the proposed design meets the customer's specification. It is expected that the learner will, during the design processes, make full use of appropriate information and communication technology Course aim is to scrutinize the design process in its entirety, from problem definition to conceptualization to embodiment and realization, in a discipline-independent framework, with the purpose of gaining insight into the process from the most general viewpoint.

learning outcomes

On successful completion of this unit a learner will:
1 Be able to prepare a design specification to meet customer requirements
2 Be able to analyse and evaluate possible design solutions and prepare a final design report
3 Understand how computer-based technology is used in the engineering design process.

theoretical teaching

Customer requirements: all relevant details of customer requirements are identified and listed eg aesthetics, functions, performance, sustainability, cost, timing and production parameters; all relevant regulations, standards and guidelines are identified
Design parameters: implications of specification parameters and resource requirements are identified and matched; the level of risk associated with each significant parameter is established
Design information: all relevant information is extracted from appropriate reference sources; techniques and technologies used in similar products or processes are identified; use of new technologies are specified where appropriate; relevant standards and legislation are identified and applied throughout; design specification is checked against customer requirements

practical teaching

Examples of application of analytic design methods. Axiomatic design of products, processes and systems. Application of axiomatic design in manufacturing domain. Defining functional requirements for manufacturing system. Design for manufacturing, design of manufacturing processes and intelligent machines. Intelligent system for design of manufacturing systems. Project and

prerequisite

Defined by curriculum of study programme/module.

learning resources

(1) I-TRIZ Innovation WorkBench – a comprehensive software tool for inventive problem solving.
(2) I-TRIZ Ideation Brainstorming – a simplified tool for solving problems of light to medium

complexity.
(3) Axiomatic design software

number of hours

lectures: 35
research: 0

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

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
N. P. Suh, (1990) THE PRINCIPLES OF DESIGN, Oxford University Press, New York
G. J. Park, (2007) ANALYTIC METHODS FOR DESIGN PRACTICE, Springer Verlag, London

Application of Fracture Mechanics to Structural Integrity

ID: PhD-3248
teaching professor: Sedmak S. Aleksandar
ECTS credits: 5

goals

Course objectives are that students, after completing basic course in theory of fracture mechanics, and with their maximum involvement in practical training (through laboratory exercises, development of computational tasks, writing seminar papers, etc.), become competent in assessment of safety and integrity of structures. Students learn about possible practical applications of fracture mechanics based on a double-sided interpretation of its parameters, when setting up the fracture mechanics triangle provides an estimation of reliability structures. The practical application of fracture mechanics in order to prevent failure of real structures is analized. The potential co-operation with experts in the field of fracture mechanics is allowed, and through theoretical and practical training the appropriate academic skills are acquired, and they 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 of structural integrity, and to examine the possible consequences that may occur in case of bad solutions. By attending this course students will master the prediction techniques of residual strength of structurs with cracks, fracture toughness testing techniques for metallic materials and welds. Students learn about issues involving analysis and diagnosis of behavior and lost of integrity, life assessment and rehabilitation of structures. It is anticipated to master weak spot prediction techniques in structural design, even before the appearance of cracks, as well as structural assessment when an error is detected using nondestructive testing methods.The student will also able to link their knowledge in this field with other areas and apply them in practice.

theoretical teaching

Application of fracture mechanics to structural integrity assessment.Initiation of a crack in a weldment. The possibility of using fracture mechanics criteria to assess safety of welded joints. Mechanical structures integrity considering fracture toughness. Damage mechanics and its application to ductile fracture. Estimates in the domain of elasticity and elasto-plasticity. Residual strength assessment of pressure vessels with surface errors using the resistance curves. Crack growth force in relation to the tensile engineering materials curves. Fracture mechanics analysis and allowed defect size curves for surface cracks in pipes. Fatigue surface crack growth in welded joints. Determination of fracture mechanics parametars with thermo mechanical load. J integral as the law of conservation. Direct measurement of the J integral. Local access.

practical teaching

Standard procedures for the fracture mechanics measurement, as material properties. Fracture diagram analysis and its application to welded joints and structures. Application of linear elastic fracture mechanics. Application of the leak principles before fracture design. The application of elastic-plastic fracture mechanics. CTOD design curve. Failure Assessment Diagrams. PD6493 procedures. R6 method. J-integral analysis of crack growth. Structural integrity assessment using acquired knowledge. Directly measuring the J integral - Reed's original work. Examples of modifications - the strength and heterogeneity of material. An example of two-dimensional stress analysis - pressure vessels. Assessment of properties of welded joints using standard cracked specimens. Consultation.

prerequisite

learning resources

[1] Written lessons from lectures (handouts)
[2] A. Sedmak, Use of the fracture mechanics on the structure integrity assessment, Faculty of Mechanical Engineering, Belgrade, 2003.
[3] T.L. Anderson, Fracture Mechanics: Fundamentals and Applications, 3rd ed, CRC Press, London, 2005.
[4] G Jovicic., Zivkovic M., S Vulović., Computational fracture mechanics and fatigue, Faculty of Mechanical Engineering, Kragujevac, 2011.
[5] Marko. P. Rakin, Local access to a ductile fracture of metallic materials. TMF, Belgrade, 2009.
[6] S. Sedmak, A. Sedmak, Experimental and numerical methods of fracture mechanics in structural integrity assesment, TMF, Belgrade, 2000.
[7] Excerpts from the standard

number of hours

lectures: 35
research: 0

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): 40

references

T.L. Anderson, Fracture Mechanics: Fundamentals and Applications 3rd ed. CRC Press, London, 2005.
Jin Z. H., Sun C.T., Fracture Mechanics, Academic Press, 2011.
G. Pluvinage, Fracture and Fatigue Emanating from Stress Concentrators, Springer, Dordrecht, 2004.
A. Sedmak, S. Sedmak, LJ. Milović, Pressure eljuipment inegrity assessment bz elastic-plastic fracture mechanics methods, monografija, DIVK, Beograd, 2011.
Broek D., The Practical Use of Fracture Mechanics, Springer, 1989.

Applied Industrial Computational Engineering

ID: PhD-3344
teaching professor: Radojević LJ. Slobodan
ECTS credits: 5

goals

The aim of the subject is to teach doctoral candidate one way of verifying the results of a scientific experiment. As the need to reduce the number of repetitions of the experiment, a doctoral candidate in this course will be taught how to set up the model verifies each repetition of the experiment.

learning outcomes

The doctoral candidate will be able to assess the quality of the model set or found solutions. During the assessment, the candidate will use linear regression and Monte Carlo simulation method.

theoretical teaching

1. The linear regression model of one variable.
2. Linear regression model of two variables.
3. Computer applications in linear regression modeling.
4. Nonlinear regression model of one variable.
5. The best regression line of one variable.
6. Computer use in finding the best regression line.
7. Basics of Monte Carlo simulations.
8. Monte Carlo simulations of the distribution of different types of random variables.

practical teaching

Using various computer applications processed sample data and make a conclusion about his behavior. The conclusion is made on the basis of multiple regression lines obtained. Specifically deals with polynomial regression line of one variable. It is used to obtain the best regression line. As the experiment is not repeated, the Monte Carlo method is used to verify the results. In the process of obtaining a regression line and Monte Carlo simulation have been used a number of well-known computer applications.

prerequisite

Standard course of Programming tools, Numerical Methods and Industrial Statistics.

learning resources

The necessary software for this course under the GNU license - free of charge.
This especially applies to the spreadsheet table.
Also Faculty of Mechanical Engineering has a license for the Mathlab software.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 0; calculation tasks: 0; seminar works: 45; project design: 0; final exam: 50; requirements to take the exam (number of points): 50

references

Aquaphotomics

ID: PhD-3107
teaching professor: Koruga LJ. Đuro
ECTS credits: 5

goals

The goal is to teach students the latest findings about physical, chemical and biological properties of water. Students will learn to understand interaction of water and light, and how the chains and clusters of water molecules are formed. Students will learn different methods of spectroscopy for water characterization.

learning outcomes

After this course students will be able to do spectroscopic characterization of water, determine the influence of ions and other impurities, to analyze how the water molecules are organized, to simulate i predict interactions with biomolecules, in the first place, interaction of water with DNA and proteins.

theoretical teaching

1.Water and life. Theories of the water origin on Earth, and in Solar system. Water and origin of life. Water content in human organs. Water in embryogenesis. Water and pathological conditions.
2.Water molecule. Vibration modes of water molecules.
3.Hydrogen bonds. Relations and dynamics of covalent O-H and hydrogen O...H bond. Hydrogen bonds in pure 18.2 MΩ water,in water with low, medium and high ion content.Molecular vibrations and water absorption.
4.Paramagnetism and diamagnetism of water. Theoretical and experimental basics. Paramagnetism and diamagnetism of PSE. Paramagnetism/Diamagnetism dynamics for 18.2 MΩ water, ionized water and ionized water after reverse osmosis.
5.Physical states of water. Theory and experiments:organization of water in liquid water, liquid crystalline, water clusters, solid state. Water and exclusion zone.
6.Intracellular and extracellular water. Extracellular water content, intracellular water content. Regulation mechanisms.Aquaporins.
7.Interaction of water and biomolecules. Hydrophobicity and hydrophilicity. Interaction of water with aminoacids and proteins, sugars, nucleic acids, DNA, lipids etc.
8.Water−light interaction: in UV,VIS,IR and terahertz domain. Representation and analysis using classical methods.
9. Aquagrams. Basics of aquagrams, the data used for developing aquagrams. Advantages of using aquagrams.
10.Opto-magnetograms. Basics of opto-magnetograms, required data. Advantages of using opto-magnetograms comparing to classical methods for spectral plots.

practical teaching

UV-vis and IR spectroscopy of water (deionised, ionised water with different ions, and different percentages of ions). Forming of aquagrams for waters exposed to light and sound. Data processing and analysis.

prerequisite

Enrolled doctoral studies.

learning resources

1. Minispectrometer Hamamatsu, TM-VIS/NIR C10083CA, 320-1000 nm
2. Minispectrometer Hamamatsu, TG-COOLED NIR-I C9913GC, 900-1700nm
3. OMS-B53, opto-magnetic spectrometer with Brewster angle 53, Nanolab, Faculty of Mechanical Engineering

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Nollet,L.M., Handbook of water analysis, CRC Press, Boca Raton, 2007
Jeffrey,G., An Introduction to Hydrogen Bonding, Oxford University Press, New York, 1997
Pollack,G., Water and Cell, Springer, Doderchet, 2006
Lynden-Bell, R. Water and life, CRC Press, Boca Ratom,2010.
Ho, M-W., Living Raibow H2O, World scientific, New Jersy, 2012

Artificial Intelligence & Machine Learning

ID: PhD-3353
teaching professor: Miljković Đ. Zoran
ECTS credits: 5

goals

The main goal of Artificial Intelligence (AI) and Machine Learning (ML) is to program computers to use example data or past experience to solve a given problem. Many successful applications of machine learning exist already, including systems that analyze past sales data to predict customer behaviour (financial management), recognize faces or spoken speech, optimize robot behaviour so that a task can be completed using minimum resources, and extract knowledge from bioinformatics data, etc.
AI & ML presents an overview of basic AI methods for machine learning research. The specific goals of this course follow:
• To provide historical context about AI, primarily over the past 20 years;
• To enable PhD students to study a chosen specific AI methods such as artificial neural networks;
• To study basic machine learning research in detail;
• To give PhD students insight into software tools for simulation of neural networks.

learning outcomes

AI and ML is a comprehensive course on the subject, covering topics not usually included in introductory machine learning. It discusses AI methods based in different fields, including neural networks, signal processing, control, and data mining, in order to present a unified treatment of machine learning problems and solutions. All basic learning algorithms are explained so that the PhD student can easily move from the equations to a computer program, such as BPnet or Matlab.

theoretical teaching

After an introduction that defines machine learning and AI paradigms, the course covers clustering, decision trees, supervised learning, competitive learning, reinforcement learning, multilayer perceptrons, intelligent agent interactions within an environment, and software tools for simulation of neural networks.
Main topics of the course are:
* What is Machine Learning?
* Artificial Intelligence – A Guide to Intelligent Systems (Fuzzy; ANNs; GA, etc.).
* Artificial Intelligence – Clustering; Decision Trees; Expert Systems.
* Supervised Learning; Competitive Learning; etc.
* Artificial Neural Networks (ANNs) – Multilayer Perceptrons.
* Reinforcement Learning (Q-learning) – The intelligent agent interacts with an environment.

practical teaching

Class activities consist of presentations and discussions (classroom & Moodle) as well as computer simulation of neural networks - exercises based on BPnet and Matlab software tools:
* Introduction to BPnet software – simulation of backpropagation neural net.
* Introduction to Matlab software – neural network toolbox.
* Neural networks – exercises to solve a given problem; Seminar paper assignment - Homework.

Homework consists of mandatory reading study questions and research leading to a seminar paper with final presentation.

prerequisite

MSc degree of technically oriented faculty.

learning resources

[1] Software packages (BPnet, ART Simulator, Matlab), Laboratory CeNT, University of Belgrade, Faculty of Mechanical Engineering, 18.13
[2] Laboratory mobile robot prototype (Khepera II, LEGO Mindstorm NXT), Laboratory CeNT, University of Belgrade, Faculty of Mechanical Engineering, 18.12
[3] Z. Miljković, Software "Moodle" for distance learning (http://147.91.26.15/moodle/), University of Belgrade, Faculty of Mechanical Engineering, 2012, 18.13

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

S.J. Russel, P. Norving, (2003-2nd ed.,1995-1st ed.) ARTIFICIAL INTELLIGENCE – A MODERN APPROACH, Prentice Hall.
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.
Golden,R.M., (1996) MATHEMATICAL METHODS FOR NEURAL NETWORK ANALYSIS AND DESIGN, MIT Press.
Freeman, J.A., Skapura, D.M., (1991) NEURAL NETWORKS – ALGORITHMS, APPLICATIONS AND PROGRAMMING TECHNIQUES, Addison-Wesley Publishing Company.

Artificial Intelligence of Motor Vehicles

ID: PhD-3000
teaching professor: Aleksendrić S. Dragan
ECTS credits: 5

goals

The basic goal is research and development of scientific support aiming for improvement of motor vehicles performance on the level of their an intelligent and autonomous operation.

learning outcomes

Development of students' abilities for conducting scientific research in the area of artificial intelligence of motor vehicles.

theoretical teaching

Lectures are based on consultation with students in accordance with the previously issued research tasks.

practical teaching

Practical lectures will be coordinated with the students research tasks.

prerequisite

There is no pre condition.

learning resources

Aleksendrić D., Ćirović V. Inteligentno kočenje,(knjiga u pripremi), 2012.
Miljković Z., Aleksendrić D. Veštačke neuronske mreže - zbirka rešenih zadataka sa izvodima iz teorije, Mašinski fakultet Beograd, 2009.
Savaresi S., Taneli M. Active Braking Control Systems Design for Vehicles, Springer 2010.
Li L., Wang F.Y. Advanced Motion Control and Sensing for Intelligent Vehicles, Springer, 2007.
Bishop R. Intelligent Vehicles Technology and Trends, Artech House INC, 2005.
Vachtsevanos G., Lewis F.L.,Roemer M., Hess A., Wu B. Intelligent Fault Diagnosis and Prognosis for Engineering Systems,John Wiley&Sons INC,2006.
Mas F.R., Zhang Q., Hansen A. Mechatronics and Intelligent Systems for Off-Road Vehicles, Springer, 2010.

number of hours

lectures: 35
research: 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

Automatic Control of Dynamic Systems

ID: PhD-3377
teaching professor: Lazić V. Dragan
ECTS credits: 5

goals

Introduction to basic concepts in the field of Automatic Control and the training for the implementation and the verification of the acquired knowledge to specific physical systems and processes.
Acceptance of some methodologies for the analytical and experimental verification of the basic static and dynamic characteristics and parameters of the system.
Learning basic MATLAB tools to help in the 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 the mechanical engineering. The basic dynamic and static characteristics and parameters of the system in the 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 the training is based on the simulation using MATLAB.
Presentation of the systems and physical values by the standard symbols, labels and understanding of control principles based on the 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 the Faculty.
• Freeware software.
• PCs.

number of hours

lectures: 35
research: 0

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

Ogata Katshuhiko, "Modern Control Engineering", Prentice Hall, Uper Saddle River, NJ 2002.
Tewari Ashish, "Modern Control Design with Matlab and Simulink", John Wiley & Sons, Chichester, England 2002.
Frederick O. Smetana, "Introduction to the Control of Dynamic Systems", American Institute of Aeronautics and Astronautics, Inc., Washington, DC, 1994
Joseph DiSetano III, Allen Stubberud, Ivan Williams, "Schaum's outline of Feedback and Control Systems", McGraw-Hill, New York, 1967

Autonomous systems and machine learning

ID: PhD-3167
teaching professor: Miljković Đ. Zoran
ECTS credits: 5

goals

Autonomous Systems (AS) include development of intelligent machines capable to fulfill working tasks in manufacturing environment through hardware-software integration, without explicit human control. Considering the production technologies of the 21st century which include hardware-software integration of AS, especially robots, as well as automative subsystems, this subject aims to qualify PhD students for independent development of modern manufacturing systems and processes, their modelling, until implementation of advanced technologies within the intelligent manufacturing systems based on theoretical and practical aspects of new algorithms and methods in domain of artificial intelligence.

learning outcomes

Starting from the fundamental concepts, this subject includes scientific multidisciplinarity in accordance with biological bases through perspective development realization in the fields of intelligent control, artificial life and application of autonomous systems in robotized production technologies of the 21st century. The outcome of this subject is oriented towards scientific progress of PhD students, especially through intensive scientific experimental research work in domain of hardware-software integration of AS within advanced technologies of the 21st century (machine Q-learning; soft computing techniques of artificial intelligence, etc.).

theoretical teaching

Theoretical education is organized in several parts: • Autonomousness and control of machine systems - Biologically inspired control of intelligent machines; • Fundamental structural elements of AS - Sensor-actuator relation; • Software architecture for autonomous systems - Hierarchical architecture; Reactive and behavioral architecture; Hybrid architecture; Open architecture; • What is machine learning? - Nature of learning; Probabilistic approach to machine learning; • Empirical control - Algorithm of empirical control; Application and influence of axiomatic design theory on empirical control development; • Control of mobile robots family - Centralized control of common mobile robot colony; • Trends of development of autonomous robots - Micro- nano-robots; Potential risks of intensive development of autonomous robots.

practical teaching

Practical education is organized in several parts: • Localization and mapping of manufacturing environment (laboratory work); • Communicative and interactive competence of robots in working environment (laboratory work); • Machine learning and control (laboratory work); • Robot learning (laboratory work); Evolutive algorithms; Learning by imitation; • Architecture of intelligent control of mobile robots (laboratory work); Heterogeneous robotic teams and cooperative work; Reconfigurability of mobile robots; • Self-organizing, autonomous evolution and self-replication of robots.

prerequisite

MSc degree of technically oriented faculty.

learning resources

[1] Z. Miljković, D. Aleksendrić, ARTIFICIAL NEURAL NETWORKS – solved examples with theoretical background, Textbook, University of Belgrade, Faculty of Mechanical Engineering, 2009, 18.1 /In Serbian/
[2] M. Kalajdžić (editor), Lj. Tanović, B. Babić, M. Glavonjić, Z. Miljković, et al., CUTTING TECHNOLOGY (7th ed.), Handbook, University of Belgrade, Faculty of Mechanical Engineering, 2012, 18.1 /In Serbian/
[3] 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/
[4] B. Babić, FLEXY - Intelligent system for FMS design, Series IMS, Vol. 5, University of Belgrade, Faculty of Mechanical Engineering, 1994, 18.1 /In Serbian/
[5] Laboratory mobile robot prototype (Khepera II, LEGO Mindstorm NXT), Laboratory CeNT, University of Belgrade, Faculty of Mechanical Engineering, 18.12
[6] Laboratory model of designed manufacturing system, Laboratory CeNT, University of Belgrade, Faculty of Mechanical Engineering, 18.12
[7] Software packages (BPnet, ART Simulator, Matlab, AnyLogic, Flexy), Laboratory CeNT, University of Belgrade, Faculty of Mechanical Engineering, 18.13

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Z.Miljković, D.Aleksendrić, ARTIFICIAL NEURAL NETWORKS–SOLVED EXAMPLES WITH THEORETICAL BACKGROUND (in Serbian). University of Belgrade–Faculty of Mechanical Engineering, Belgrade, (2009).
R. Siegwart, I.R. Nourbakhsh, INTRODUCTION TO AUTONOMOUS MOBILE ROBOTS, MIT Press, Cambridge, Massachusetts, (2004).
G.A. Bekey, AUTONOMOUS ROBOTS: From Biological Inspiration to Implementation and Control, The MIT Press, Cambridge, Massachusetts, London, England, (2005) .
R.A. Brown, MACHINES THAT LEARN, Oxford University Press, (1994).
E. Alpaydin, INTRODUCTION TO MACHINE LEARNING, The MIT Press, Cambridge, Massachusetts, London, England, (2004) .

Basic Principles of Fracture Mechanics

ID: PhD-3247
teaching professor: Sedmak S. Aleksandar
ECTS credits: 5

goals

Course objectives are for the students to understand the basic principles of fracture mechanics theory. Introducing students to the application of fracture mechanics in the analysis of various engineering problems. Introducing students with analytical and experimental methods for the determination of fracture mechanics parameters. Analysis of damage and fracture mechanics using finite element method. The potential co-operation with experts in the field of materials science, which provides the ability to work in specialized laboratories.

learning outcomes

By attending this course students will master the basic principles in the field of fracture mechanics. Theoretical considerations and computational examples enable student to master all the necessary principles and standards in the field of fracture toughness tests of materials. Students master the methods of theoretical analysis and correlation of elsatoplastic fracture mechanics, microstructural investigations and constitutive expression of continuum mechanics, in order to avoid fracture in metallic materials and their compounds. Introducing students to the existing modern standards and recommendations in the given field, using experimental tests.

theoretical teaching

Basic assumptions of elastic-plastic fracture mechanics of materials. Main subject of investigation in fracture mechanics. Classification of fractures. Fracture mechanics parameters of engineering materials. Stress field at the crack tip. Analysis of the brittle fracture problem. Stress intensity factor. Fracture toughness- critical value for stress intensity factor.Crack tip opening. J - contour integral. J integral as a parameter for stress and deformation fields. Nonlinear energy release rate. The connection between the J integral and CTOD. The zone of final stretch. Local access to metallic materials fracture. Local approach in the analysis of crack formation and ductile fracture. Analytical determination of stress intensity factors. Analytical determination of the crack opening and the J integral . REI model. King's model. Experimental determination of fracture mechanics parameters. Numerical determination of fracture mechanics parameters. Finite element fracture analysis.

practical teaching

Application of fracture mechanics standards. The application of the J integral on crack growth analysis. Empirical formula for the CTOD. EFAM ETM97. EPRI engineering procedures. Experimental determination of fracture mechanics parameters. Determination of fracture toughness. Determination of the critical crack tip opening. Experimental determination of J integral - standard procedure. Measuring the strength of the final zone. Experimental methods for determining the microstructural properties of metallic materials. Numerical methods for determining fracture mechanics parameters. Recommendations of the European Association for Structural Integrity (ESIS).

prerequisite

learning resources

1] Written lessons from lectures (handouts)
[2] A. Sedmak, Use of the fracture mechanics on the structure integrity assessment, Faculty of Mechanical Engineering, Belgrade, 2003.
[3] T.L. Anderson, Fracture Mechanics: Fundamentals and Applications, 3rd ed, CRC Press, London, 2005.
[4] G Jovicic., Zivkovic M., S Vulović., Computational fracture mechanics and fatigue, Faculty of Mechanical Engineering, Kragujevac, 2011.
[5] Mark. P. Rakin, Local access to a ductile fracture of metallic materials. TMF, Belgrade, 2009.

number of hours

lectures: 35
research: 0

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): 40

references

T.L. Anderson, Fracture Mechanics: Fundamentals and Applications 3rd ed. CRC Press, London, 2005.
Jin Z. H., Sun C.T., Fracture Mechanics, Academic Press, 2011.
G. Pluvinage, Fracture and Fatigue Emanating from Stress Concentrators, Springer, Dordrecht, 2004.
J. N. Reddy, An Introduction to the Finite Element Method (Engineering Series), 2005.
Roger T. Fenner, Finite Element Methods for Engineers, 1997.

Basics of Composite Material Mechanics

ID: PhD-3354
teaching professor: Balać M. Igor
ECTS credits: 5

goals

Main objective of the course is to teach students the fundamental principles of the mechanics of composite materials. This theory is further applied to design and analyze unidirectional and multidirectional fiber composite laminates. Within the course the basic issues associated with the design of composite materials will be studied as well. A special attention will be devoted to the practical stress and strain analysis of mechanical components made out of composite materials. Issues connected to the characterization of mechanical properties of composite materials will be tackled as well.

learning outcomes

1. Within the course students will learn various methods of the assessment of elastic constants entering into constitutive equations which describe mechanical behavior of composite materials. Problems of determination of macro behavior of composite materials starting from known properties of components entering into it will be tackled as well. The course will cover also the study of different failure criteria for various types of composite materials.
2. Students will learn how to perform stress – strain analysis of laminate composite materials.
3. The course will devote some attention to the influence of the environmental conditions (e.g. temperature and humidity) to the variation of mechanical properties of composite materials. This will be studied with a special focus on unidirectional and multidirectional composite laminates.
4. By completing this course students will become familiar with basic concepts of mechanics of composite materials. A special attention will be devoted to the practical procedures of stress analysis of mechanical components made out of composite materials, with numerical implementation of the most frequently used techniques.

theoretical teaching

1. Introduction to composite materials: Basic concepts. Classification, main characteristics and the most frequent applications of composite materials in modern engineering.
2. Macro mechanical elastic behavior of unidirectional lamina composites. The Hooke's Law for a two dimensional lamina. Determining stiffness of parallel arrays of fibers in matrix. Rules of mixture. Off-axis properties of a lamina.
3. Determining strength of unidirectional lamina. Analysis of failure criteria. Diverse failure criteria and their applications.
4. Macro mechanical elastic behavior of multidirectional composite laminates. Stress and strain analysis of single lamina, and of the entire composite material. General laminate plate theory. Studding of coupling effects – coupled flexure and torsion.
5. Stress – strain and failure analysis of multidirectional composite materials. Strength of lamina under tension and shear. Inter-laminar stresses. Laminate strength analysis. First ply failure.

practical teaching

1. Analytical examples of the assessment of macro mechanical properties of the composite materials.
2. Examples of the Hooke's law theory applied to the two dimensional unidirectional laminates. Determining of the stiffness matrix for the composite material.

3. Numerical exercises of stress strain analysis of laminate composites. Examples of determination of local and global values for stress and strain.
4. Numerical examples of determination of the ultimate strength using diverse failure criteria. Practical applications of failure theory to the ultimate strength calculations of mechanical components made out of composite materials.
5. Examples of numerical implementations of diverse modeling techniques of composite materials into the available codes. Comparison of numerical and analytical predictions of composite material component behavior.

prerequisite

Taken exams:
Strength of materials
The base of strenght of constructions

learning resources

The whole course material is well covered by hand-outs written by the lecturers of the course. Every attendee of the course will be provided his/hers own copy of the hand-outs. Apart of this, all the below mentioned books can be borrowed from the lecturers during the course or ordered on some relevant websites.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 40; laboratory exercises: 0; calculation tasks: 5; seminar works: 20; project design: 0; final exam: 30; requirements to take the exam (number of points): 40

references

"Mechanics of composite materials", Autar K. Kaw
"Principles of composite materials mechanics", Ronald F. Gibson
"Mechanics of Elastic Composites", Nicolaie Dan Cristescu, Eduard-Marius Craciun and Eugen Soós
"Mechanics of Composite Materials with MATLAB" George Z. Voyiadjis and Peter I. Kattan
"Mechanics of composite materials", Robert M. Jones

Behaviour and reliability of materials during exploitation

ID: PhD-3314
teaching professor: Šijački Žeravčić M. Vera
ECTS credits: 5

goals

The aim of the course is for students to acquire knowledge regarding the behavior of materials in exploitation (i.e. under conditions of creep, fatigue, residual stresses and corrosion), their reliability during exploitation, as well as factors determining their reliability. The basic goal of the course is for students to recognize the complexity of the relation material – working parameters – working environment with all consequences that can follow, causes of fractures in constructions and loss of reliability in use. They should also be able to understand the precautions necessary for achieveing reliability during use.

learning outcomes

After fulfilling all the course requirements, as prescribed by the course plan, the student is capable of applying the acquired knowledge to: solve specific problems regarding detection and recognition of types of material damage during exploitation; determine potential causes of damage; as well as to recognize possibilities for preventing occurrence of further damage. Student is also capable of combining the acquired knowledge in this ares to other areas, and to apply them in practice.

theoretical teaching

Big failures and construction fractures worldwide. Tetrahedron material/construction – working environment – working parameters – reliability. Reliability. Fundamentals of theory of creep, resistance of materials to creep, relevant factors, mechanisms of developing damage under creep conditions, material degradation, development of pores, cracks, crack propagation and fractures. Fatigue, relevant factors especially concerning materials and material faults, nucleation of cracks, their propagation in different environments and fractures. Residual stresses and their significance, types of residual stresses and their influence on material properties, techniques for measuring and procedures for reducing them. Corrosion, types of corrosion, mechanisms of corrosion, corriosion damage tendency of materials in different environments and destruction due to corrosion and combined mechanisms. Methods for assessing lifetime and increasing reliability.

practical teaching

Metallography. Calculating coefficient of stress concentration in presence of defects. Probability of fracture occurrence. Types of fractures. Creep strenght. Degradation in microstructures. Examples of corrosion damage. Analytical diagnostics. Writing of reports. Criteria for replacement and reparation. Technical norms. New steels for high temperatures.

prerequisite

Obtained master degree (M.Sc.) and knowledge about material science.

learning resources

1. Chadek Ya: The Creep of metal Materials, Moscow, Mir, 1987
2. Ridel H.: Fracture at High Temperature, Berlin, Heidelberg: Springer-Verlag, 1987
3. M. G. Fontana, Corrosion engineering, McGraw, Hill International Editions, 1987

4. Milnie, Ritchie et.al: Practical failure method, Comprehensive Structural Integrity, Vol 7, Elsevier, 2003
5. D.R.H.Jones, Failure analysis case studies, Elsevier Science, 2001

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

1. David Roylance: Statistics of fracture, Cambridge, 2001
2. Milnie, Ritchie et.al: Cyclic Loading and fatigue, Comprehensive Structural Integrity, Vol 4, Elsevier, 2003
3. Milnie, Ritchie et.al: Creep and high-temperature failure, Comprehensive Structural Integrity, Vol 5, Elsevier, 2003
7. Korozija termoenergetskih postrojenja, Monografija - Tehnološko metalurški fakultet, Mašinski fakultet (Šijački Žeravčić V., Bakić G., Đukić M.), NI Vinča, EPS, Beograd, 2002
8. V. Šijački Žeravčić: Zaostali naponi – Monography, Fac. of Mech.Eng. Belgrade, 1999

Bioaumatics

ID: PhD-3237
teaching professor: Ribar N. Srđan
ECTS credits: 5

goals

Introduction of PhD students with special types of neural networks. Getting to know the use of complex neural networks for data classification of biomedical measurements for diagnostic purposes.

learning outcomes

Students acquire the ability to analyze issues related to the field of bioregulation mechanism, the formation of mathematical models of biological systems using contemporary analytical methods, procedures, techniques, and computer equipment. Students are trained to master the synthesis of knowledge of anatomy, physiology, automatic control and signal processing in order to achieve accurate models of biological systems.

theoretical teaching

Introduction to the bioautomatics, a division of the system, the biosphere. Wildlife, organizing systems, adaptation and regulation. Functional parts of the human body, cells and cell function. Proteins as building blocks of living systems, amino acids, nucleic acids. Tubulin protein structure, function, microtubules, centiole, regulatory processes in the cell. DNA, RNA, regulation and adaptation at the cellular level. Senses as sensors, types, roles. Eyesight, function, defining subsystems and interactions with the environment. Sensors in robotics, advanced sensor technology.

practical teaching

Mathematical modeling of the system, examples. Mathematical modeling of animal world system. Mathematical modeling of subsystems in the human body, the mathematical model of the cell. Mathematical modeling of the dynamic and static properties of amino acids and proteins, primary and secondary structure of proteins. Work on STM / AFM device, visualization of protein structures. Mathematical modeling of the dynamic characteristics and regulatory processes of microtubules and centrioles. Mathematical modeling of DNA regulatory processes. Work on STM / AFM device visualization DNA of the cell. Mathematical modeling of the senses. Mathematical modeling of sight, vision sensors. Mathematical modeling of 3D images, 3D image acquisition. Acquisition of data from sensors and processing.

prerequisite

Enrolled doctor studies

learning resources

1. John L. Johnson, Mary Lou Padget,"PCNN Models and Applications", IEEE TRANSACTIONS ON NEURAL NETWORKS, Vol 10, No 3, May 1999,480-498.
2. Srdjan N. Ribar, "HYBRID SOFTWARE SYSTEM FOR DIAGNOSIS OF BIOPHYSICAL STATE OF SKIN BASED ON EXPERT SYSTEM, NEURAL NETWORKS, FUZZY LOGIC AND GENETIC ALGORITHMS", Ph.D. Thesis, 2011.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

John L. Johnson, Mary Lou Padget,"PCNN Models and Applications", IEEE TRANSACTIONS ON NEURAL NETWORKS, Vol 10, No 3, May 1999, 480-498.
Srdjan N. Ribar, "HYBRID SOFTWARE SYSTEM FOR DIAGNOSIS OF BIOPHYSICAL STATE OF SKIN BASED ON EXPERT SYSTEM, NEURAL NETWORKS, FUZZY LOGIC AND GENETIC ALGORITHMS", Ph.D. Thesis, 2011.

Bioautomatics

ID: PhD-3108
teaching professor: Koruga LJ. Đuro
ECTS credits: 5

goals

Introduction of PhD students with special types of neural networks. Getting to know the use of complex neural networks for data classification of biomedical measurements for diagnostic purposes.

learning outcomes

Students acquire the ability to analyze issues related to the field of bioregulation mechanism, the formation of mathematical models of biological systems using contemporary analytical methods, procedures, techniques, and computer equipment. Students are trained to master the synthesis of knowledge of anatomy, physiology, automatic control and signal processing in order to achieve accurate models of biological systems.

theoretical teaching

Introduction to the bioautomatics, a division of the system, the biosphere. Wildlife, organizing systems, adaptation and regulation. Functional parts of the human body, cells and cell function. Proteins as building blocks of living systems, amino acids, nucleic acids. Tubulin protein structure, function, microtubules, centiole, regulatory processes in the cell. DNA, RNA, regulation and adaptation at the cellular level. Senses as sensors, types, roles. Eyesight, function, defining subsystems and interactions with the environment. Sensors in robotics, advanced sensor technology.

practical teaching

Mathematical modeling of the system, examples. Mathematical modeling of animal world system. Mathematical modeling of subsystems in the human body, the mathematical model of the cell. Mathematical modeling of the dynamic and static properties of amino acids and proteins, primary and secondary structure of proteins. Work on STM / AFM device, visualization of protein structures. Mathematical modeling of the dynamic characteristics and regulatory processes of microtubules and centrioles. Mathematical modeling of DNA regulatory processes. Work on STM / AFM device visualization DNA of the cell. Mathematical modeling of the senses. Mathematical modeling of sight, vision sensors. Mathematical modeling of 3D images, 3D image acquisition. Acquisition of data from sensors and processing.

prerequisite

Enrolled doctor studies

learning resources

1. John L. Johnson, Mary Lou Padget,"PCNN Models and Applications", IEEE TRANSACTIONS ON NEURAL NETWORKS, Vol 10, No 3, May 1999,480-498.
2. Srdjan N. Ribar, "HYBRID SOFTWARE SYSTEM FOR DIAGNOSIS OF BIOPHYSICAL STATE OF SKIN BASED ON EXPERT SYSTEM, NEURAL NETWORKS, FUZZY LOGIC AND GENETIC ALGORITHMS", Ph.D. Thesis, 2011.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

John L. Johnson, Mary Lou Padget,"PCNN Models and Applications", IEEE TRANSACTIONS ON NEURAL NETWORKS, Vol 10, No 3, May 1999, 480-498.
Koruga, Đ., Neurocomputing: Control systems in biology, Nanobiology, Vol.1 No.1 No1,pp.4.16, 1993
Koruga,D., Molecular networks as a sub-neural factor of neural network, BioSystems, Vol.23, No.4. pp 297-304, 1990

Biofluid mechanics – advanced course

ID: PhD-3266
teaching professor: Stevanović D. Nevena
ECTS credits: 5

goals

The aim of this subject is getting knowledge about certain class of biological processes from the fluid mechanics point of view and introducing with scientific methods for predicting, analyzing and studying fluid dynamical processes in the human body.

learning outcomes

Students are qualifying for computing and analyzing by themself biofluid flow processes with contemporary and scientific methods. Also, they obtain the ability to apply these concepts appropriately for modeling biofluid flow in blood vessels, kidneys, lungs and joints.

theoretical teaching

Theoretical lessons incorporates: understanding of biofluid properties and applications of the fundamental laws (mass, momentum, and energy) that govern fluid mechanics to solve biofluid flow such as those in the cardiovascular system, introducing with basic non-Newtonian fluid models especially rheology of biofluids which are present in the human body, introducing with cardiovascular system and related diseases, circulatory system, steady and unsteady biological flows and wave propagation theory and oscillatory flow, defining velocity, pressure and flow rate in the blood vessels, modelling blood flow and diffusion process in kidneys, diffusion process in haemodialyser, blood and air flows in the lungs, joint friction, as well as modelling hydrodynamic separation of particles and cells, and hydrodynamic phenomena in drug-delivery systems.

practical teaching

Practical lessons contains applications of the basic fluid mechanics equations to solve biofluid flows such as: creating and solving mathematical models for blood vessels flow, solving models for stationary blood flow in rigid and elastic blood vessels, modeling pulsating fluid flow, calculation of the pressure wave propagation, calculation of the velocity, pressure and flow rate in blood vessels, modeling and calculating diffusion process among blood vessels walls and tissues and application on the haemodialys process and renal flow.

prerequisite

Passed exams in Fluid Mechanics.

learning resources

Course handouts.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 40; requirements to take the exam (number of points): 50

references

Waite L., Fine J., Applied Biofluid Mechanics, MsGraw-Hill, 2007.
Mazumdar, N.J., Biofluid Mechanics, World Scientific, 1992.
Kleinstreuer, C., Biofluid Dynamics, Principles and Selected Applications, Taylor & Francis, 2006.
Fung, Y.C., Biomechanics Motion, Flow, Stress and Growth, Springer-Verlag, 1990.

Biomedical chronodynamics

ID: PhD-3109
teaching professor: Koruga LJ. Đuro
ECTS credits: 5

goals

The goal of the course is for the student to get to know the concepts of biological time and biological rhythms. To understand that the biological rhythms are the consequence of the complex position of Earth at the Solar system and in Universe, and that they are under constant influence of environment. To understand that some the diseases and various pathological states are the consequence of the disruptions of biological rhythms and how this findings could help in biomedical diagnostics and therapy.

learning outcomes

After the course student has learned the latest findings about biological rhythms and main influences of the rhythms. Student has also learned about what disrupts the biological rhythms, and how the organs and systems of organs in human organism react if the natural biological rhythms are disrupted. Student also knows what illnesses are the consequence of the biological rhythms disruptions, and how it can be treated. Students are able after the course to implement this new knowledge in their biomedical practice.

theoretical teaching

1.Introduction to Biomedical Chronodynamics and its importance. Basic terms and definitions. Time – definition. Biological time – definition. Biological clock and its functional significance.. Applications of biomedical chronodynamics results in medicine.
2.Movement of celestial bodies and biorhythms: daily, weekly, monthly and yearly rhythms. Examples of biological rhythms. Basic characteristics of biological rhythms. Circadian rhythm. Pacemaker of circadian rhythm.
3. Movement of celestial bodies and byorhythms :
Rotations and revolutions of planets in Solar system. The golden mean law and Solar system. Deterministic chaos and rhythms of planets in Solar system. Rhythms of micro and nano gravitation effects of the Sun, the Moon and planets of the Solar system on the surface of the Earth
4.History of studying biorhythms : Mesopotamia, Egypt, Mayas and other civilizations
Measuring time as physical property. Measuring of biological time. Chronobiometry.
5.Influence of natural light cycles, micro and nano gravitation on biorhythms
Molecular basics of periodicity. Photoperiodism.
6.Embryogenesis and biorhythms.
7. Significance of studying biorhythms in gynecology
8.Significance of studying biorhythms in perinatology
9.Skin, aging and rhythms
10.Cardiovascular system rhythms
11.Significance of studying biorhythms in pathogenesis and therapy of malignant diseases
12. Significance of studying biorhythms in neurodegenerative and autoimmune diseases
13. Significance of studying biorhythms in neurology and psychiatry
14. Significance of studying biorhythms in medicament therapy

practical teaching

UV and vis-NIR spectroscopy of biological samples - embryonic water, blood, urine under different perturbations (light, sound - pleasant and unpleasant, illness, pathological states, healthy state). Processing and analysis of the results.

prerequisite

enrolled doctoral studies

learning resources

1. Minispectrometer Hamamatsu, TM-VIS/NIR C10083CA, 320-1000 nm
2. Minispectrometer Hamamatsu, TG-COOLED NIR-I C9913GC, 900-1700nm
3. OMS-B53, opto-magnetic spectrometer with Brewster angle 53, Nanolab, Faculty of Mechanical Engineering

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Koruga Dj., Raznatovic S., Miljkovic S. , Tomic A., Muncan J., Biomedical chronodynamics (in Serbian), in press
Youan B.C. (ed.), Chronopharmaceutics, Science and technology for Biological Rhythm-Guided Therapy and Prevention of Diseases, Wiley&Sons, USA, 2009
Koukkari W.L., Sothern R.B., Introducing biological rhythms, Springer, USA, 2006

Bionics

ID: PhD-3230
teaching professor: Rašuo P. Boško
ECTS credits: 5

goals

Introducing students to the process and the procedure of synthesis (create) a combination of mechanical systems engineering design (design) and industrial and bionic design. Besides, the goal of this course is to develop creative skills of students in the design of machines. Understanding the methodology and procedures to create innovative mechanical system through the phase of designing, selection of parameters, dimensions and shape of machine parts, alignment features (functional and aesthetic) with the environment, living and working environment.

learning outcomes

The student is introduced to the procedure of abstract thinking and creative idea generation, the development methodology of the new principal, conceptual, based on bionic solutions. Dressed in designing machine parts and assemblies based on bionic principles, functional, technological, aesthetic, ergonomic, and others. Trained to implement budgets for the mutual adjustment of parameters of machine parts with the limitations, the development of forms and sizes.

theoretical teaching

Experience in engineering: flying, navigation, civil engineering, architecture, and military construction. Inclusion bionic aspects in the design process and construction of mechanical systems. Mathematical principles of bionic system. Fibonacci sequence. Fibonacci spiral. "Gold" section (the relationship) and "Golden" angle. The influence of the golden ratio in engineering design. The concept of fractals and fractal geometry. Cantor set. Euclid’s natural forms. The effects of scale, form and similarity in nature and their impact on the development of modern machine design and systems. Energy efficiency of natural systems as models in the design of modern engineering structures, the experience of flight, navigation, energy, process engineering, military technology and others. Natural (bionic) building materials. Modern composite materials. Thermoplastic and thermosetting materials in engineering. "Smart" and functional materials in engineering structures and modern design.

practical teaching

Influences Leonardo da Vinci, Sir George Cayley, Ota Liliental, Gustav Ajfel, Raul Fransea and Graf von Zeppelin. Bio-strategy application process in fulfilling the spirit of laws rules of biological evolution, which should translate into an acceptable technical solution. Ten basic principles of natural structures. Implementation bionic humanoid proportions and impact on the ergonomic design. Some typical relations (numbers) that characterize the specific effects of similarity and scaling in nature. Bionic Design - views and role models. Wood, vegetable fiber, animal,: wool, silk, spider web, etc.. Natural resins. Artificial resins - matrix (binder) materials: Epoxy, Polyester, Vinyl ester, phenolic, polyimide, Bizmaleimid et al. Cellular materials, intelligent optical fiber. Electrical and magnetic reostatic. Semiconductor spinotronic. Magnetic materials. DNA nano-products.

prerequisite

No special requirements

learning resources

Laboratory for Design in Mechanical Engineering, Books, Werner Nachtigall, Biologisches Design, Springer-Verlag Berlin Heidelberg 2005, include necessary material for lectures, exercises, 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

lectures: 35
research: 0

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: 45; final exam: 40; requirements to take the exam (number of points): 40

references

Werner Nachtigall, Biologisches Design, Springer-Verlag Berlin Heidelberg 2005
Mircea Gh.Negoita, Sorin Hintea, Bio-InspiredTechnologies for the Hardware of Adaptive Systems, Springer-Verlag, Heidelberg, 2009
Ranjan Vepa, Biomimetic Robotics - mechanisms and control, CAMBRIDGE UNIVERSITY PRESS, Cambridge, 2009

Boundary Layer and Control of Separation

ID: PhD-3379
teaching professor: Stefanović A. Zoran
ECTS credits: 5

goals

Course extends gas dynamic basic concepts to theory of boundary layer and applications in fluid flow control of separation of flow. It covers a wide range of topics including vortex based control algorithms, non-compressible turbulent boundary layers, aerodynamic flow control, control of mixing and reactive flow processes or nonlinear modeling and control of combustion dynamics. Course material varies each academic year depending upon the focus of the design problems.

learning outcomes

After the Course completion students will develop a basic understanding of viscous flows in general, and boundary layer flows, in particular. They will be capable of recognizing particular difficulties associated with these flows and conditions under which valid simplifications can be made so that solutions can be obtained of an appropriate accuracy

theoretical teaching

Viscous flow phenomena and the effects of Reynolds number variations. Viscous stresses and the Navier-Stokes equations. Phenomenology of the boundary layer and separation of flow. Momentum integral equation. Laminar boundary layers. Hydrodynamic instability. Transition and turbulent boundary layers. Pressure gradients in boundary layer flow. Steady boundary layer flows (flow close to a surface, flow across the entire section, turbulence-modelling, flow resistance. Statistical analysis (correlation analysis, spectrum analysis). Shock wave - boundary layer interaction. Principles for the Control of Flow Separation. Passive and active principles for control of flow separation. Methods of boundary layer control and flow separation prevention.

practical teaching

Practical part of course demonstrate the numerical examples in variety of areas of different boundary layers and separation of flow problems. Practical work of students is realized through a virtual classroom available 24 hours (program MOODLE). In the workshop students have approach to the professor's written notes, lectures and tests for practice. Each student works and study problems individually.

prerequisite

none

learning resources

This course has a virtual classroom on the Internet. At the first lecture students are enrolled and trained for work (Moodle software). In the workshop approach is performed with the lectures and exercises, guidelines for project design, internet resources, quizzes, etc.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Zoran Stefanović, Zlatko Petrović . Handouts for Boundary Layer and Control of Separation, Faculty of Mechanical Engineering, 2012.
H.Schlichting, K.Gersten: Boundary Layer Theory, Springer, 2004
Paul Chang: Control of flow separation (Vol I, Vol II & Vol III), McGraw-Hill, 1976

CAI model

ID: PhD-3141
teaching professor: Majstorović D. Vidosav
ECTS credits: 5

goals

Detailed study of the metrology product modeling techniques. Generating knowledge for practical application of geometric, technological and metrology product models in everyday engineering practice. Developing skills for research and development of metrology modeling.

learning outcomes

After completion of the teaching process, students will have the necessary research and development of knowledge for understanding and solving the problem of integration of metrology projektovalja product planning and technology planning measurement / inspection. It will enable students to effectively understand, investigate, implement and improve engineering metrology problems and how to solve geometric - technology - metrology and integration.

theoretical teaching

Advanced models for product modeling, metrology product models. Metrological interfaces. GPR model products. Metrology primitives - geometric primitives / relationship. Semantic model of tolerance metrology. Intelligent metrology. Selected examples of application. Our research in this area. Research problems in this area.

practical teaching

1. Geometric modeling tolerance length, form, angles, position and geometry (micro / macro) surfaces.

2. Complex metrology product model - real product.

prerequisite

Faculty degree, primarily technical.

learning resources

1. Lectures for each lesson in electronic form (handouts)
2. Textbook - Мајсторовић, В., TQM for manufacturing systems. MEF, Belgrade, 2005.
3. Web Site of subject - to includes material under 1 a bibliography of reference books, journals, and links with the addresses of the leading organizations and major institutions in this area.
4. Technical base case - Laboratory for Production Metrology and TQM, which has the necessary equipment and licensed software for training in this subject.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Weckemann, A., Advanced Metrolgy Modelling, Springer Verlag, London, 2009.
Osanna, H., Durakbasa, N., Intelligent Metrology, TU Vienna, 2010.
Мајсторовић, В., TQM for manufacturing systems. MEF, Belgrade, 2005.

Combined Cycles with Gas Turbines & Steam Turbines

ID: PhD-3367
teaching professor: Petrović V. Milan
ECTS credits: 5

goals

1. The achievement of research and expert competence in combined cycles.
2. The achievement of high level of theoretical knowledge
3. The acquisition of research and expert knowledge to optimize combined cycles.
4. The achievement of the techniques of process modeling.
5. Mastering the methods of experimental work in thermal power engineering.

learning outcomes

1. Expert and research deep knowledge of the thermodynamic combined cycles in thermal power engineering
2. The development of critical thinking about energy use, fuel efficiency and environmental preservation
3. The ability of calculate heat balance combined cycles.
4. Ability to use computer technology for modeling and calculations

theoretical teaching

Combined cycles and their applications. Thermodynamic background of the CCGT. Design and off-design performance of combined cycles. Advanced cycles. One-, two- and three- pressure cycles. The basic and main thermodynamic parameters. Performance and Economics. Energy and exergy analysis.
Project: Calculation of the heat balance of the CCGT plant. Optimization of the basic thermodynamic parameters.

practical teaching

Project: Calculation of the heat balance of the CCGT plant. Optimization of the basic thermodynamic parameters.

prerequisite

PhD student - therma power engineering.

learning resources

Literature. Computing devices.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Petrovic, M: Gas turbines and Turbocompressors, scrip, 2004.
Stojanovic, Themal Turbomachinery, Gradjevinska knjiga, Belgrade, 1967.
R.H. Kehlhofer Combined-Cycle Gas Steam Turbine Power Plants, PennWell 1999.
Horlock J.H.: Advanced Gas Turbine Cycles, Elsevier, 2003.
A.Bejan, G. Tsatsaronis, M. Moran: Thermal Design and Optimization, Wiley, 1996.

Competitive Manufacturing Management

ID: PhD-3392
teaching professor: Miljković Đ. Zoran
ECTS credits: 5

goals

Competitive Manufacturing Management presents basic methods and new approaches for understanding the world of manufacturing, where every aspect of operations management must be highly responsive to customer needs.
The specific goals of this course follow:
• To show PhD students how to create and maintain valid and realistic master schedules;
• To study a practical guide to competitive manufacturing;
• To give PhD students insight into all areas of a company within the framework of an effective master schedule.

learning outcomes

Master scheduling (MS), as a part of Enterprise Resource Planning (ERP) and Supply Chain Management (SCM), is an essential planning process that helps manufacturing companies synchronize their planned product supply with anticipated market demand.
This course includes the ideal guide for any PhD student (especially competitive manufacturing manager of the main board in the future work) who wants to avoid the most common mistakes while consistently maximizing the accuracy and performance of the master schedule.

theoretical teaching

The course Competitive Manufacturing Management covers all the basic concepts as well as new approaches and explains how to create and manage a master scheduling system, perform rough-cut capacity planning and complete the planned process using finishing and final assembly techniques aimed at delivering the requested product to the customer on time and in full.
Main topics of the course are:
* Competitive Manufacturing Management - Role and Scope.
* Chaos in Manufacturing; What is the Master Schedule - MS?
* The Mechanics of MS and Managing with the MS.
* What to Master Schedule? The Flow Manufacturing Environment.
* Master Production Scheduling (MPS) & Advanced Techniques.
* Using MPS Output in a Make-to-Order Environment.
* Master Scheduling in Custom-Product Environments.
* Manufacturing Strategy and Finishing Schedules.

practical teaching

Other relevant topics (exercises to solve a given problem) covered include scheduling in discrete as well as flow environments, warranty decisions, demand and supply management, sales and operations planning and effective implementation:
* Sales, Operations Planning and Rough Cut Capacity Planning.
* Product Warranty and Manufacturing; Warranty Decisions.
* Supply, Demand and Warranty Management.
* Effective Implementation.

prerequisite

MSc degree of technically oriented faculty.

learning resources

[1] Software packages (BPnet, ART-Simulator, Matlab), Laboratory CeNT, University of Belgrade, Faculty of Mechanical Engineering, 18.13

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

John M. Nicholas, (1998) COMPETITIVE MANUFACTURING MANAGEMENT, Irwin McGraw-Hill.
John F. Proud, (2007) MASTER SCHEDULING, 3rd edition, John Wiley & Sons, Inc.
D.N. Prabhakar Murthy, Wallace R. Blischke, (2006) WARRANTY MANAGEMENT AND PRODUCT MANUFACTURE, Springer-Verlag London Ltd.
Thomas E. Vollmann, William L. Berry, D. Clay Whybark, F. Robert Jacobs, (2005) MANUFACTURING PLANNING AND CONTROL FOR SUPPLY CHAIN MANAGEMENT, McGrawHill.
E. Alpaydin, (2004) INTRODUCTION TO MACHINE LEARNING, The MIT Press, Cambridge, Massachusetts London, England.

Computational Engineering

ID: PhD-3337
teaching professor: Radojević LJ. Slobodan
ECTS credits: 5

goals

The aim of the subject is to provide doctoral candidate knowledge representation and placement of various problems in Operations Research using computers. Using the transformation of large matrices, candidates will be able to replicate the process of resolving to the appropriate parts of computer applications.

learning outcomes

Doctoral candidates will recognize the problem from Operations Research and prepare an appropriate data structure, the matrix for its solution. Also, the candidate will be able to determine the basic matrix transformations, as well as the transformations that characterize the Operational Research. Types of matrix transformations depend on the properties of the obtained matrix, which will require the use of a multidisciplinary doctoral candidate knowledge.

theoretical teaching

1. Basic facts of Linear programming and representation with large matrix.
2. Solving linear programming problems: the Simplex method and matrix transformations.
3. The theory of the Simplex method and computer implementation.
4. Dynamic programming and computer implementation.
5. Game theory and large matrix.
6. Game theory and decision applications.
7. Introduction to Markov chains and Queueing theory.
8. Markov decision process and applications.

practical teaching

1. Prototype example, and Linear programming model. Model representation with large matrix and basic assumptions.
2. The algebra of Simplex method. Tabular form of Simplex method. Representation with large matrix and partial transformations of matrix.
3. The breaking in the Simplex method and presentation results with submatrix.
4. Probabilistic dynamic programming and computer implementation.
5. Solving problems in Game theory by Linear programming and representation with large matrix.
6. Solving simple games and decision applications.
7. Chapman - Kolmogorov equations and power of matrix.
8. Examples of real queueing systems and various way of computer and mathematics representations.

prerequisite

The basic course of Operations Research, Numerical Methods and Programming.

learning resources

The necessary software for this course under the GNU license - free of charge.

Also Faculty of Mechanical Engineering has a license for the Mathlab software.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 0; calculation tasks: 0; seminar works: 45; project design: 0; final exam: 50; requirements to take the exam (number of points): 50

references

Computational Fluid Dynamics

ID: PhD-3366
teaching professor: Petrović I. Zlatko
ECTS credits: 5

goals

Educate students to understands foundatons of fluid flow simulations and develop ability to design simulation software.

learning outcomes

Ability to develop software, simulate and model fluid flow problems.

theoretical teaching

Computational grid generation. Transformation of flow equations between physical and computational domain. Potential flow simulation. Solution of Euler equations. Parabolized Navier-Stokes Equations, boundary layer flows. Solution of full Navier-Stokes Equations. Turbulence modelling. Turbulent models and flow simulations. High temperature flows

practical teaching

Each theoretical topic is illustrated with multiple examples wich illustrate solution procedure and the procedure of the presentation of results.

prerequisite

Prerequestity: Advanced computational method course

learning resources

Computer laboratory, laptop, projector.

number of hours

lectures: 35
research: 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: 60; final exam: 30; requirements to take the exam (number of points): 40

references

Klaus Hoffmann, "Computational Fluid Dynamics for Engineeris", Engineering Education System, Austin
Lecture Slides

Computational fluid dynamics of buildings and vehicles

ID: PhD-3282
teaching professor: Stupar N. Slobodan
ECTS credits: 5

goals

The course deals with problems of fluid flow around buildings and road and rail vehicles. The goal of this course is to introduce students to the influences that atmospheric flows have on objects in terms of loading and the impact of the flow around the vehicle on vehicle performance. Determination of wind loads on buildings, bridges and other structures have a large influence on the design and sizing of structural elements. The student becomes familiar with the numerical calculation of flow around objects, solve practical problems and compares the results with the recommendations in the industry standards. Large development of automobile industry caused a large amount of research in the field of aerodynamics in order to improve vehicle performance and vehicle efficiency. Learning about the theoretical foundations of aerodynamics in parallel with the techniques of numerical calculations that are used in the determination of the aerodynamic forces on the vehicle as well as the influence of these forces on the performance and efficiency of the vehicle the student acquires a global view of the problem of vehicle aerodynamics and the ways in which they can be solved.

learning outcomes

After passing the course, students gain practical and theoretical knowledge that will serve as a basis for further research and practical work. By adopting the exposed material the student is able to independently deal with the problems of aerodynamics of buildings and vehicles and to use simple numerical techniques for solving them. While solving course assignments students are trained to use modern software tools and to develop and solve simple mathematical models with their own computer code.

theoretical teaching

Introduction, Basis of fluid mechanics, Wind in the atmosphere, Wind forces, Static wind load on buildings and structures, Dynamic wind load on buildings and structures, Basics of numerical simulation of problems in fluid mechanics
Importance of vehicle aerodynamics and aerodynamic forces, Ground effects, Drag and efficency, Noise, Numerical methods and use of Computational Fluid Dynamics (CFD), Wind-tunnels

practical teaching

Solving of problems of building and vehicle aerodynamics by numerical methods, Exercises in aerodynamics of road vehicles, Exercises in rail vehicle aerodynamics, Exercises in aerodynamics of building and structures, Introduction to the regulations and standards in the field of aerodynamics of building and structures, Visit to the wind tunnel

prerequisite

There is no necessary requirement for attendance of computational fluid dynamics of buildings and vehicles

learning resources

Simlab - computer laboratory

number of hours

lectures: 35
research: 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

Petrovic Z, Stupar S, CFD one, Faculty of Mechanical Engineering, 1992
Ferziger J., Perić M., Computational Methods for Fluid Dynamics, Springer Verlag, 1999.
Katz J.,Race Car Aerodynamics: Designing for Speed, Bentley Publishers, 2003.
Selected research articles and conference papers.
Additional materials (lecture hand-writings, problem settings, task solving guidelines)

Computational Fracture Mechanics

ID: PhD-3249
teaching professor: Sedmak S. Aleksandar
ECTS credits: 5

goals

Introduce students to the possibilities of numerical methods application to problems of fracture mechanics. Introducing students to the application of finite element method in the analysis of nonlinear problems. Understanding and studying the problems of coupled external loads on welded structures. The development of an independent and practical work using licensed software.

learning outcomes

By attending this course the student will master advanced application of finite element method, especially in the field of welding and welded structures. The importance of the application of computational fracture mechanics to structures when there are already noted one or more of the initial cracks. Students are trained to use computational methods to determine whether the stress fields on the constructions will lead to further growth of the crack, and whether crack will be stable or unstable, and based on that can determine the remaining life of the structure. Theoretical considerations, computational exercises and work with the licensed software, will allow students to synergize the previously acquired knowledge of mathematics, mechanics, structures integrity and mechanical materials, and apply this knowledge in engineering practice.

theoretical teaching

Elastic and elastic-plastic fracture mechanics. Fracture mechanics parameters. Stress intensity factor, crack tip opening, J integral. Application of fracture mechanics in structural integrity. Solving nonlinear problems using the FEM; types of nonlinearities, a review. Introduction to nonlinearity of the materials, the basics of the theory of plasticity. Presentation of the different criteria of plastic flow of materials in the FEM. The influence of building up the material. The influence of material anisotropy. The problem of heterogeneous materials - application on the welded joints. Problems of the material porosity. Viscoplasticity. Algorithms for solving nonlinear problems; incremental - iterative procedures. Nonlinearity of geometry; analysis of large deformations. Viscoelasticity. Nonlinear boundary conditions: solution for contact problems using formulation of FEM.Application of FEM in fracture mechanics and failure. Singular FE. Calculations of J-integrals in the FEM. Crack growth, techniques of node release. Determination of stress intensity factors using numerical methods. Adaptive finite element meshes and their application in the analysis of stress concentration. Numerical analysis in the local approach. The extended finite element method.

practical teaching

Determination of fracture mechanics parameters in elastic and elastic-plastic field. Experimental, numerical and analytical methods.Application of various algorithms in solving nonlinear problems; the accuracy and convergence of the solutions. Examples of FEM formulation of nonlinearities of geometry. Developments of FEM contact models. FEM formulation of dynamic and impact loadings. Post-processing. Techniques of introducing residual stresses - application on different welding procedures. FEM solutions in assessing fracture integrity of the weld. Examples of calculating J-integral for welded joints. Numerical determination of stress intensity factors in the real structure. Numerical simulation of crack propagation using XFEM.

prerequisite

learning resources

[1] Written lessons from lectures (handouts)
[2] Kojic M., Computational Prrocedures in Inelastic Analysis of Solids and Structures, Kragujevac, 1997.
[3] Sekulović M., The finite element method, Građevinska knjiga, Beograd, 1988.
[4]A. Sedmak, Use of the fracture mechanics on the structure integrity assessment, Faculty of Mechanical Engineering, Belgrade, 2003.
[5] G Jovicic., Zivkovic M., S Vulović., Computational fracture mechanics and fatigue, Faculty of Mechanical Engineering, Kragujevac, 2011.
[6] Marko. P. Rakin, Local access to a ductile fracture of metallic materials. TMF, Belgrade, 2009.
[7] S. Sedmak, A. Sedmak, Experimental and numerical methods of fracture mechanics in structural integrity assesment, TMF, Belgrade, 2000.

number of hours

lectures: 35
research: 0

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): 40

references

Kojic M., Computational Prrocedures in Inelastic Analysis of Solids and Structures, Kragujevac, 1997.
Reddy J. N.,An Introduction to the Finite Element Method, McGraw-Hill: New York, 2005.
Mohammadi S., Extended finite element method for fracture analysis of structure, Blackwell Publishing Ltd., Oxford, UK, 2008.
O. C. Zienkiewicz, R. L. Taylor and J.Z. Zhu, The Finite Element Method: Its Basis and Fundamentals, Sixth Edition, 2005
T.L. Anderson, Fracture Mechanics: Fundamentals and Applications 3rd ed. CRC Press, London, 2005.

Computational Multi-Fluid Dynamics

ID: PhD-3265
teaching professor: Stevanović D. Vladimir
ECTS credits: 5

goals

The aim of the subject is developing skills for the simulation and analyses of multiphase flows in complex geometries of components in energy plants.

learning outcomes

Students are trained to develop mathematical models of multidimensional multiphase flows, to solve these models with computational multi-fluid dynamic methods and to conduct simulation and analyses with the aim of designing and analyzing the operation of equipment of complex geometry in energy plants.

theoretical teaching

Balance equations for multiphase flow. Closure laws for interfacial transport phenomena. Control volume based numerical methods. SIMPLE type solving algorithms. Interface tracking techniques.

practical teaching

Computer simulations of boiling two-phase flows in steam generators and heat exchangers.

prerequisite

Attended courses in Fluid Mechanics, Thermodynamics and Numerical methods within maser or doctoral studies.

learning resources

Course handouts.
Stevanović, V., Thermal-Hydraulics of Steam Generators – Modelling and Numerical Simulation, Monograph, Faculty of Mechanical Engineering, Belgrade, 2006.
Computer equipment.
Software for numerical solving of systems of differential equations of various types.
Software for simulation and analyses of pressure transients in pipeline networks and pressurized vessels.
Software for simulation and analyses of multidimensional two-phase flows.

number of hours

lectures: 35
research: 0

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): 0

references

Prosperetti, A., Tryggvason, G., Computational Methods for Multiphase Flows, Cambridge University Press, 2007.
Brennen, C.E., Fundamentals of Multiphase Flow, Cambridge University Press, 2005.
Stevanovic, V., Thermal-Hydraulics of Steam Generators – Modelling and Numerical Simulation, University of Belgrade, Faculty of Mechanical Engineering, 2006.
Kolev, N.I., Multiphase Flow Dynamics 1: Fundamentals, Springer, 2011.
Versteeg, H.K., Malalasekera, W., An introduction to Computational Fluid Dynamics, Longman Group Ltd., Harlow, 1995.

Computer Based Measurements

ID: PhD-3286
teaching professor: Tomić V. Miroljub
ECTS credits: 5

goals

The aim of the course is to provide comprehensive insight into the digital acquisition systems (DAQ), measurment systems 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 DAQ software developing and testing.
This course is, mainly, intended for students not closely familiar with the computer based measurement techniques at level needed for PHD studies, as well for those who are willing to extend their knowledge in this area.

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. Fundamentals of signal filtering (Analog & Digital); Hardware components of the DAQ module –DAQ device; Basic principles of digital data acquisition; DAQ based measurement chaines for the measurement of a temperatures, pressures, forces, torques, speed, acceleration,...; Specific issues on digital input/output of DAQ devices; Counters and their usage for counting of discrete events and position measurement; 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

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0; test/colloquium: 0; laboratory exercises: 10; calculation tasks: 0; seminar works: 0; project design: 80; final exam: 10; requirements to take the exam (number of points): 70

references

Labview Core 1 & 2 Course Manual & Exercises, National Instruments
Robert H. King:Introduction to Data Acquisition with LabVIEW,McGraw-Hill,2009,
Fernando Puente León, Uwe Kiencke:Messtechnik: Systemtheorie für Ingenieure und Informatiker, Springer, 2011

Computer calculated and structure diagnostics

ID: PhD-3145
teaching professor: Maneski Đ. Taško
ECTS credits: 5

goals

Mastering of the Diagnostics Method and an active work on the computer. Modeling and calculation of complex structures and problems. Determination Finding the real structure behavior in its operation. Reliable prediction of structural response and determination the cause of bad behavior, yielding and damage of structure. Static, thermal and dynamic analysis.

learning outcomes

The course provides skills to diagnostics behaviour of structures using computers and Finite Element Method. This allows solving the real problems of structural strength in its service life. Mastering the course will enable the application on different areas and active work on the computer using finite element method.

theoretical teaching

Introduction. Based method of stucture behaaviour diagnostics. The based of modeling. Static and thermal analysis. Dynamic analysis. Analysis of the calculation of structure. Computer modeling and calculation of real problems. Load distribution in the structure. Diagnosis of the strength of structure behaviour. Elements of structure optimization.

practical teaching

Working with Programe package KOMIPS. The tasks from line primitives. The tasks of surface primitives. The tasks of volume primitives. Principles of computer modeling and generation of structure geometry. Adding primitives to generate finite element meshes. Computer modeling of supports and loads. Exercise of collecting primitives and generating network elements. Exercise of defining the characteristics of elements, supports and loads. Examples of static and thermal calculation. Examples of dynamic calculation. Diagnostics of structural behavior. Seminar papers from modeling, calculations, load distribution on the structure, analysis of structure calculation, defining elements of structure optimization.

prerequisite

No conduction

learning resources

1. T. Maneski, Computer modeling and calculation of structures, Faculty of Mechanical Engineering, 1988 - KPN
2. T. Maneski, V.Milošević-Mitic, D. Oštrić, The statement of structural strength, Faculty of Mechanical Engineering, Belgrade, 2000 - KPN
3. T. Maneski, Resolved problems of structural strength, faculty of Mechanical Engineering, Belgrade, 2000 - KPN
4. KOMIPS - a software package for the calculation of structures - ICT - IAS

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Computer modeling and structure calculation

ID: PhD-3146
teaching professor: Maneski Đ. Taško
ECTS credits: 5

goals

Mastering of the Computer modeling and structure calculation and an active work on the computer. Modeling and calculation of complex structures and problems. Determination of displacements and stresses. Reliable prediction of structural response and determination the cause of bad behavior, yielding and damage of structure. Static, thermal and dynamic analysis.

learning outcomes

The course provides skills to acquisition modeling and design of structures using computers and Finite Element Method. This allows solving the real problems of structural strength in its service life. Mastering the course will enable the application on different areas and active work on the computer using finite element method.

theoretical teaching

Introduction. Finite element modeling of the geometry of the supporting structures. The theory of elasticity. Finite element method. Line, сурфаце анд волуме проблем. Static and thermal analysis. Dynamic analysis. Analysis of the calculation of structure. Computer modeling and calculation of real problems. Load distribution in the structure. Diagnosis of the strength of structure behaviour. Elements of structure optimization.

practical teaching

Working with Programe package KOMIPS. The tasks from line primitives. The tasks of surface primitives. The tasks of volume primitives. Principles of computer modeling and generation of structure geometry. Adding primitives to generate finite element meshes. Computer modeling of supports and loads. Exercise of collecting primitives and generating network elements. Exercise of defining the characteristics of elements, supports and loads. Examples of static and thermal calculation. Examples of dynamic calculation. Diagnostics of structural behavior. Seminar papers from modeling, calculations, load distribution on the structure, analysis of structure calculation, defining elements of structure optimization.

prerequisite

No condition

learning resources

1. T. Maneski, Computer modeling and calculation of structures, Faculty of Mechanical Engineering, 1988 - KPN
2. T. Maneski, V.Milošević-Mitic, D. Oštrić, The statement of structural strength, Faculty of Mechanical Engineering, Belgrade, 2000 - KPN
3. T. Maneski, Resolved problems of structural strength, faculty of Mechanical Engineering, Belgrade, 2000 - KPN
4. KOMIPS - a software package for the calculation of structures - ICT - IAS

number of hours

lectures: 35

research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Contemporary biomedical diagnostic methods and devices

ID: PhD-3111
teaching professor: Koruga LJ. Đuro
ECTS credits: 5

goals

To introduce students with modern diagnostic methods and devices such as semi-invasive and non-invasive measurement of blood glucose, dermoscopy methods of diagnosing skin lesions, cancers and melanoma.

learning outcomes

Mastering of the methods, procedures, tools, analyzing the results and writing report.

theoretical teaching

Structural, biophysical and biochemical properties of molecules of glucose, glucose metabolism. Concentration of glucose in the blood. Causes of the types of diabetes. Classical measurement of glucose in the blood. Structure and function of the skin. Transcutar invasive, non-invasive measurement and semi-invasive measurement glucose in the blood. Dermoscopic characterization methods of skin (skin lesions, skin cancer and melanoma). Getting to know and work on dermoscopic devices.

practical teaching

Introduction to methods and apparatus for glucose measuring. Measurement of blood glucose and analyzed.
Introduction to methods and apparatus for image and dermoscopy. Image processing and ABCDE-based algorithm for diagnostic. Converting digital recording images into convolution spectroscopic diagram. Analyzed. Report writing. Hyperspectral image analysis and spectrum.

prerequisite

Enrolled doctoral studies

learning resources

1. Invasive device for measuring the concentration of glucose in the blood, Accu-Check, Roche, Switzerland
2. non-invasive device for measuring the concentration of glucose in the blood OMS-B60, DIA Systems, USA
3. dermoscopic BEST device, ORS Hospital, Belgrade

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Bronzino, J.D., Biomedical Engineering (Handbook), CRC Press, Boca Raton, 1995
Obradović, B., Cell and Tissue Engineering, Springer, Berlin 2012.
Carpertner, A., Cecil essentials of medicine, Saunders, Philadelphia, 1997

Contemporary Biomedical Engineering

ID: PhD-3116
teaching professor: Koruga LJ. Đuro
ECTS credits: 5

goals

The main objective of this course is to introduce students in a modern methods and techniques for diagnosis and treatment using a light, to train them to use devices, as well as to explain obtained results. In addition, they will be able to propose new solutions and to increase sensitivity and specificity of existing methods and techniques.

learning outcomes

The main objective is to train researcher who can work independently at the device, as well as to be able to plan, conduct and analyse experiments of the doctoral thesis, or to participate in the team at the clinic for the early diagnosis of cancer epithelial tissues (skin, oral cavity, cervix and colon).

theoretical teaching

Introduction in diffuse, polarized, monochromatic and others type of lights. Biomedical photonics, spectroscopy (UV-VIS, NIR) spectroscopy opto-magnetic, image processing, signal processing, hyper spectral image analysis, image analysis and fractal signals, neuro-fuzzy algorithms. Light therapy (depression, injuries, wounds, etc.).

practical teaching

Introduction to the work of opto-magnetic spectroscopy device. The skin scanning by a camera, than image processing, and convolution spectral diagrams drawing. The procedures of oral swabs and cervical smears preparation. The processing and analysis of results. The comparison of obtained results to the results obtained by histopathology. The identification of traumas and injuries before and after the treatment by polarized light, static and oscillating magnetic field.

prerequisite

To be enrolled in doctoral studies.

learning resources

1. The device OMS-B53, NanoLab, Faculty of Mechanical Engineering
2. Keyence VHX-100 Digital Microscope, magnification up to 1000 times
3. Magneto generator for static and oscillating magnetic field, NanoLab MF
4. UV-VIS (290-800 nm) and NIR (800-2200nm) spectrometers, Hamatcu, JapanNano-Lab the cabinet 300

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10; test/colloquium: 0; laboratory exercises: 15; calculation tasks:

0; seminar works: 20; project design: 25; final exam: 30; requirements to take the exam (number of points): 50

references

Vo-Dinh,T., Biomedical Photonics, CRC Press, Boca Raton, 2003.
Bronyino,J.D. Medical Devices and Systems, CRC Press, Boca Raton, 2006

Contemporary Biomedical Engineering

ID: PhD-3323
teaching professor: Matija R. Lidija
ECTS credits: 5

goals

The main objective of this course is to introduce students in a modern methods and techniques for diagnosis and treatment using a light, to train them to use devices, as well as to explain obtained results. In addition, they will be able to propose new solutions and to increase sensitivity and specificity of existing methods and techniques.

learning outcomes

The main objective is to train researcher who can work independently at the device, as well as to be able to plan, conduct and analyse experiments of the doctoral thesis, or to participate in the team at the clinic for the early diagnosis of cancer epithelial tissues (skin, oral cavity, cervix and colon).

theoretical teaching

Introduction in diffuse, polarized, monochromatic and others type of lights. Biomedical photonics, spectroscopy (UV-VIS, NIR) spectroscopy opto-magnetic, image processing, signal processing, hyper spectral image analysis, image analysis and fractal signals, neuro-fuzzy algorithms. Light therapy (depression, injuries, wounds, etc.).

practical teaching

Introduction to the work of opto-magnetic spectroscopy device. The skin scanning by a camera, than image processing, and convolution spectral diagrams drawing. The procedures of oral swabs and cervical smears preparation. The processing and analysis of results. The comparison of obtained results to the results obtained by histopathology. The identification of traumas and injuries before and after the treatment by polarized light, static and oscillating magnetic field.

prerequisite

To be enrolled in doctoral studies.

learning resources

1. The device OMS-B53, NanoLab, Faculty of Mechanical Engineering
2. Keyence VHX-100 Digital Microscope, magnification up to 1000 times
3. Magneto generator for static and oscillating magnetic field, NanoLab MF
4. UV-VIS (290-800 nm) and NIR (800-2200nm) spectrometers, Hamatcu, JapanNano-Lab the cabinet 300

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10; test/colloquium: 0; laboratory exercises: 15; calculation tasks:

0; seminar works: 20; project design: 25; final exam: 30; requirements to take the exam (number of points): 50

references

Vo-Dinh,T., Biomedical Photonics, CRC Press, Boca Raton, 2003.
Bronyino,J.D. Medical Devices and Systems, CRC Press, Boca Raton, 2006

Contemporary Biomedical Engineering

ID: PhD-3250
teaching professor: Sedmak S. Aleksandar
ECTS credits: 5

goals

The main objective of this course is to introduce students in a modern methods and techniques for diagnosis and treatment using a light, to train them to use devices, as well as to explain obtained results. In addition, they will be able to propose new solutions and to increase sensitivity and specificity of existing methods and techniques.

learning outcomes

The main objective is to train researcher who can work independently at the device, as well as to be able to plan, conduct and analyse experiments of the doctoral thesis, or to participate in the team at the clinic for the early diagnosis of cancer epithelial tissues (skin, oral cavity, cervix and colon).

theoretical teaching

Introduction in diffuse, polarized, monochromatic and others type of lights. Biomedical photonics, spectroscopy (UV-VIS, NIR) spectroscopy opto-magnetic, image processing, signal processing, hyper spectral image analysis, image analysis and fractal signals, neuro-fuzzy algorithms. Light therapy (depression, injuries, wounds, etc.).

practical teaching

Introduction to the work of opto-magnetic spectroscopy device. The skin scanning by a camera, than image processing, and convolution spectral diagrams drawing. The procedures of oral swabs and cervical smears preparation. The processing and analysis of results. The comparison of obtained results to the results obtained by histopathology. The identification of traumas and injuries before and after the treatment by polarized light, static and oscillating magnetic field.

prerequisite

To be enrolled in doctoral studies.

learning resources

1. The device OMS-B53, NanoLab, Faculty of Mechanical Engineering
2. Keyence VHX-100 Digital Microscope, magnification up to 1000 times
3. Magneto generator for static and oscillating magnetic field, NanoLab MF
4. UV-VIS (290-800 nm) and NIR (800-2200nm) spectrometers, Hamatcu, JapanNano-Lab the cabinet 300

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10; test/colloquium: 0; laboratory exercises: 15; calculation tasks:

0; seminar works: 20; project design: 25; final exam: 30; requirements to take the exam (number of points): 50

references

Vo-Dinh,T., Biomedical Photonics, CRC Press, Boca Raton, 2003.
Bronyino,J.D. Medical Devices and Systems, CRC Press, Boca Raton, 2006

Contemporary biomedical software

ID: PhD-3114
teaching professor: Koruga LJ. Đuro
ECTS credits: 5

goals

In this course, student acquires knowledge about contemporary software solutions that are used in the implementation of modern information systems and medical devices, as well as the fundamental principles of telemedicine as a method of remote diagnostics. Through practical examples student is introduced with techniques of medical image processing and analysis in MATLAB, and modeling of biological systems.Cooperation with experts from the fields of medicine and information technology.

learning outcomes

By attending this course student acquires theoretical knowledge related to information systems in medicine, he is trained to analyze information system organization in health care facilities, and also acquires knowledge of software solutions that are used in the application of medical systems and telemedicine. Through this course student is enabled to actively use MATLAB software in terms of image analysis and image processing.

theoretical teaching

Aspects of health informatics. Biomedical data. Electronic health record systems. Medical Information Systems. Arhitecture of existing medical softwares, advantages and disadvantages, possible changes and enhancements, standards. Specificity of software designe for medical devices. Engineering specifics requirements when developing medical software and medical information systems.
Digital image processing for medical applications. Methods of improving digital image quality, morphological image processing, image segmentation, 3D visualization of medical images in MATLAB.

practical teaching

Examples of information systems in medicine and current software applications used in those medical systems.
Development of independent programs using MATLAB: improving image quality, image segmentation and morphological operations of a digital image. Examples of graphical interfaces. Designing graphical user interface in MATLAB.

prerequisite

Enrolled PhD studies.

learning resources

Written material from lectures (handouts).

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

M. Popović, Digital Images Processing, Академска мисао, Београд, 2006.(in Serbian)
C.Solomon, T.Breckon: Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab, Wiley-Blackwell, 2010.
G. Dougherty: Digital image processing for medical application, Cambridge university press, 2009

Contemporary nanotechnology

ID: PhD-3113
teaching professor: Koruga LJ. Đuro
ECTS credits: 5

goals

The main objective of this course is to introduce students in a modern nanotechnology, modifications and manipulations at the atomic and nano level. They will be able to understand how can get intelligent materials using nanotechnology solutions. Also, they will acquire knowledge of mechatronics at the nano scale. The students will gain knowledge to understand the principles of AFM-based magnetic resonance and spin measurements.

learning outcomes

The students will be able to use NanoProbe in vacuum conditions, under the pressure and diferent temperatures. They will be trained for atoms manipulation as well as for creation of nano-forms with desired properties. The knowledge to measure the effects of spin before and after the exposure of materials to static and oscillatory magnetic field will be gained.

theoretical teaching

The basics nano-mechanics and nano-electronics will be studied as well as the principles of mechatronics at the nano level. The part of the course will be dedicated to the molecular nano magnets. In addition, a coding intelligent and nanomaterials will be taught. Operating procedures with probes of nanotubes will be studied. Procedures for using the device for modification NanoProbe structure at nanoscale will be introduced.

practical teaching

The training to work with the device with static and dynamic magnetic field will be provided as well as with the MFM module NanoProbe device. Work on NanoProbe device in a vacuum, pressure and temperature will be also part of the training. In addition, the students will be traind for atom-by-atom manipulation, nanolithography and surface modification of thin films. Measuring the effects of spin material exposed to static and oscillatory magnetic field will be taught.

prerequisite

To be enrolled in doctoral studies.

learning resources

1. NanoProbe device module MFM (JEOL, JSPM-5200, Japan)
2. JEE-420 vacuum evaporator for thin films obtaining

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

(number of points): 50

references

Srinivasan, A.V., Smart Structures: Analysis and design, Cambridge University Press, Cambridge, 2001
Avouris, P., Atomic and Nanometer-Scale Modification of Materials, Kluwer Academic Pub. Dordrecht, 1993
Gatteschi, D., Molecular nanomagnets, Oxford University Press, Oxford, 2006
Lyshevski, E.S., Nano and Molecular Electronics (Handbook), CRC Press, Boca Ratom, 2007
Hanson, G.W., Fundamentals of nanoelectronics, Pearson/Prentice Hall, 2008.

Contemporary nanotechnology

ID: PhD-3324
teaching professor: Matija R. Lidija
ECTS credits: 5

goals

The main objective of this course is to introduce students in a modern nanotechnology, modifications and manipulations at the atomic and nano level. They will be able to understand how can get intelligent materials using nanotechnology solutions. Also, they will acquire knowledge of mechatronics at the nano scale. The students will gain knowledge to understand the principles of AFM-based magnetic resonance and spin measurements.

learning outcomes

The students will be able to use NanoProbe in vacuum conditions, under the pressure and diferent temperatures. They will be trained for atoms manipulation as well as for creation of nano-forms with desired properties. The knowledge to measure the effects of spin before and after the exposure of materials to static and oscillatory magnetic field will be gained.

theoretical teaching

The basics nano-mechanics and nano-electronics will be studied as well as the principles of mechatronics at the nano level. The part of the course will be dedicated to the molecular nano magnets. In addition, a coding intelligent and nanomaterials will be taught. Operating procedures with probes of nanotubes will be studied. Procedures for using the device for modification NanoProbe structure at nanoscale will be introduced.

practical teaching

The training to work with the device with static and dynamic magnetic field will be provided as well as with the MFM module NanoProbe device. Work on NanoProbe device in a vacuum, pressure and temperature will be also part of the training. In addition, the students will be traind for atom-by-atom manipulation, nanolithography and surface modification of thin films. Measuring the effects of spin material exposed to static and oscillatory magnetic field will be taught.

prerequisite

To be enrolled in doctoral studies.

learning resources

1. NanoProbe device module MFM (JEOL, JSPM-5200, Japan)
2. JEE-420 vacuum evaporator for thin films obtaining

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

(number of points): 50

references

Srinivasan, A.V., Smart Structures: Analysis and design, Cambridge University Press, Cambridge, 2001
Avouris, P., Atomic and Nanometer-Scale Modification of Materials, Kluwer Academic Pub. Dordrecht, 1993
Gatteschi, D., Molecular nanomagnets, Oxford University Press, Oxford, 2006
Lyshevski, E.S., Nano and Molecular Electronics (Handbook), CRC Press, Boca Ratom, 2007
Hanson, G.W., Fundamentals of nanoelectronics, Pearson/Prentice Hall, 2008.

Contemporary terapeutic medical methods and devices

ID: PhD-3112
teaching professor: Koruga LJ. Đuro
ECTS credits: 5

goals

To introduce students with modern methods and techniques in the treatment of various types of diseases, and first of all with the disease which is subject of the PhD thesis. Since modern methods will be discussed separately fractal analysis of images and signals, as well as the use of algorithms based on neural networks, fuzzy logic and genetic algorithms. Will be given on the device for therapy in a variety of areas, including the most recent apparatus for the treatment of visual impairment in old age.

learning outcomes

Mastering knowledge of the latest methods, techniques and devices in the treatment of various diseases, as a basis for proposing new solutions in the areas where the student for a doctoral dissertation.

theoretical teaching

The interaction of electromagnetic radiation with a wavelength of various tissues, cells and biomolecules. Studying the range of wavelengths for the most favorable effects on tissue for the purpose of destroying or returning to normal. The study of nanomagnets, nanoparticles and quantum dots in a medical application.

practical teaching

Investigation of the effect of individual nanoparticles, light of different wavelengths and their combinations on cell culture in the Laboratory of Biomedical Engineering, and working with experimental animals in biomedical appropriate institution for doctoral theses.

prerequisite

Enrolled doctoral studies

learning resources

1. Laboratory for Biomedical Engineering - Medical biotechnology - cell culture line
2. Biomedical Laboratories Medical and Dental Faculty in Belgrade and VMA

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Bronzino, J.D., The Biomedical Engineering, CRC Press, Boca Parton, 2010
Skalak, R., Bioengineering, MecGrow Hill, New York, 2010
Bahill,A.T. Bioengineering: Biomedical, Medical and Clinical Engineering, Prentice Hall, 2001

Contemporary Trends in Ship Structural Design

ID: PhD-3189
teaching professor: Motok D. Milorad
ECTS credits: 5

goals

Explanation of reasons for significant changes of hull structure concept of some types of contemporary ships - mainly tankers, bulk carriers and container ships.Studying the influence of those changes on strength calculations and determination of hull structure scantlings.

learning outcomes

Student becomes capable of conducting calculations and procedures for contemporary ships' hull structure scantling definition.

theoretical teaching

Direct calculations of hull-girder torsion of a bulk carrier and container ship with wide hatch openings.Double hull tanker structures.Fatigue assessment of hull structure details.

practical teaching

Studying Classification societies' rules on above topics.

prerequisite

Defined by the curriculum of the studies.

learning resources

Classification societies' rules on above topics.

number of hours

lectures: 35
research: 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

***: Ship Design and Construction, SNAME, 2003.
O. F. Hughes: Ship Structural Design, John Wiley & Sons, New York 1983.
A. Mansur: Strength of Ships and Ocean Structures, SNAME, 2008.
J.K.Paik and A.K. Thayamballi: Ultimate Limit State Design of Steel-Plated Structures,John Wiley & Sons, New York 2006.

Continuum Mechanics

ID: PhD-3043
teaching professor: Golubović Đ. Zoran
ECTS credits: 5

goals

-to introduce students contemporary problems of Continuum Mechanics as the basis of separated area of Mechanics such as Theory of Elasticity, Thermoelasticity, Theory of Plasticity, Fluid Mechanics, Strength of Materials
-to introduce students to the specially mathematical methods which are constitutive parts of the Continuum Mechanics such as Tensor Calculus, Differential Geometry, Computational and Numerical Methods

learning outcomes

From theoretical point of view, Continuum Mechanics are dealing with mathematical models of real bodies. In that way it can be get to the exact formulation of corresponding physical laws of considered body behavior as reaction under mechanical, thermical, electromagnetical and chemical effects. This is important for application of reached knowledge in engineering practice.

theoretical teaching

Continuum deformation. The concept of continuum. Basic concepts of kinematics. Material and spatial derivation in time. Velocity and acceleration. Deformation tensor. Small deformation. Deformation velocity tensor. Deformation velocity tensor invariants. Connections between deformation tensor and deformation velocity tensor. Basic principles of continuum mechanics. Transport theorem. The law of mass balance. Stress. Vector and stress tensor. Stress invariants. Major stresses. The law of momentum balance. The first and second laws of thermodynamics. The law of energy balance. Motion equations of various continua. Ideal elastic body. Linear classical elasticity theory. Thermoelasticity. The theory of plastic yielding. Ideal liquid. Newtonian and non-Newtonian liquids.

practical teaching

prerequisite

Defined by the curriculum study of Phd studies program.

learning resources

Jarić J.: Mehanika kontinuuma, Gradjevinska knjiga, Beograd, 1984.
Fomin V.: Mehanika kontinuuma dlja inženjerov, Izdateljstvo Lenjigradskovo Univerziteta, Lenjingrad, 1975.
Trusdel K.: Pervonačalnij kurs racionalnoj mehaniki splošnoj sredi, Mir, Moskva, 1975.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

Jarić J.: Mehanika kontinuuma, Gradjevinska knjiga, Beograd, 1984.
Fomin V.: Mehanika kontinuuma dlja inženjerov, Izdateljstvo Lenjigradskovo Univerziteta, Lenjingrad, 1975.
Trusdel K.: Pervonačalnij kurs racionalnoj mehaniki splošnoj sredi, Mir, Moskva, 1975.

Control and Testing

ID: PhD-3362
teaching professor: Lazić V. Dragan
ECTS credits: 5

goals

Acquiring knowledge and deepening the theory of linear control systems.
Training for the implementation and testing of the acquired knowledge to concrete physical systems and processes.

learning outcomes

The knowledge gained is used in engineering practice for analysis, synthesis and verification of dynamic properties of the system.

theoretical teaching

P, PI, PD and PID control. Setting the PID controller. Integrator windup. Commercial regulators. PWM control. The analysis of state space systems. Models in state space: controllable, observable and diagonal canonical form. State space model transformation. The concept of controllability. Output controlability. The concept of observability. Stabilization by state feedback. The influence of state feedback on controllability and observability properties. Phase portrait. Lyapunov concept of stability. Properties of the system stability. The concept of controllability and observability. Overall frequency stability criteria. Introduction to the robustness of the system.

practical teaching

Analysis of the system through software tools MATLAB and Simulink. Experimental Determination of the system transfer function. Experimental setup controller.

prerequisite

Basic computer knowledge founded on PCs platforms. Басic knowledge of higher education mathematics. Basic knowledge of linear systems theory.

learning resources

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

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 45; laboratory exercises: 5; calculation tasks: 15; seminar works: 0; project design: 0; final exam: 30; requirements to take the exam (number of points): 30

references

Karl Johan Aström, Richard M. Murray, Feedback Systems, PRINCETON UNIVERSITY PRESS, New Jersey, 2008
Aström K., Hagglund, T., PID Controllers: Theory, Design, and Tuning, Instrument Society of America, Research Triangle Park, NC, 1995.
Nise N.S. Control Systems Engineering, John Wiley & Sons (Asia), 2011.
Dorf R.C., Bishop R.H., Modern Control Systems, Prentice Hall, NJ, 2008.
Franklin G.F., Powell J.D., Emami-Naeini A. Feedback Control of Dynamic Systems, Prentice Hall, NJ, 2009.

Cutting Theory

ID: PhD-3284
teaching professor: Tanović M. Ljubodrag
ECTS credits: 5

goals

Theoretical considerations of the cutting process and its phenomena, establishing the regularities of the process as a prerequisite for solving the problems of manufacturing engineering. Establishing the logic of theoretical modeling of the cutting process, systemic approach to problem solving, analysis of diverse aspects of viewing the problem and practical application of theoretical elaborations.

learning outcomes

The student should acquire knowledge and develop skills needed for advanced critical and self-critical approach to cutting theory.
Solving of concrete problems by using scientific methods and procedures.

theoretical teaching

Basics of the theory of cutting, Tool materials (Tool steels, hard metals,tool ceramics, CTM), Tool geometry and cutting layer elements (chip thickness and width), Kinematics of cutting, Chip formation (chip compression, deposits on the cutting edge, chip forms and quality of surface finish), Cutting forces (dinamometry, modeling and cutting strength), Heat and temperature in the cutting zone (heat balance and measurement), Cutting tools wear, Cutting modes in machining by turning, drilling,milling, planing, grinding and broaching of contemporary construction materials.

practical teaching

Practical teaching involves laboratory work in Laboratory for machine tools and machining systems, and seminar work writing. Planned experiments are carried out in the Laboratory with finishing the reports. These reports are a part of the seminar work.

prerequisite

MSc degree, preferably in technical sciences

learning resources

Laboratory machines: lathe, planer, radial drill, milling machine, Pfauter milling machine, grinding machine, machining centers, presses, robots, laboratory for FTS, machining processes and tools .

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

1.Kalpakjian S., Manufacturing Engineering and Technology , Addison-Wesley Pub.Com.,1995
Schey A. John , Introduction Manufacturing Processes, University of Waterloo, Ontario, 2000.
Konig W., Fertingungsverfahren Band 1 – Drehen, Frasen, Bohren, VDI Verlag,1990.
Novikov N.V., Sverhtverdie materiali. Polucenie i primenenie.monografia v 6 tomah, ISM NANU, Kiev, 2006
Tanović Lj., Petrakov Y.V., Theory and Simulation of the Machining Process, FME, Belgrade, 2007

Database Software Engineering

ID: PhD-3381
teaching professor: Radojević LJ. Slobodan
ECTS credits: 5

goals

The aim of the course is to present advanced techniques SQL.

learning outcomes

After completion of the subject, a PhD candidate will master the basic system of privilege in SQL and Query-by-Example.

theoretical teaching

1. Brief introduction to SQL.
2. Data manipulation and data definition in SQL.
3. Advance SQL - Part I. View.
4. Advance SQL - Part II. Integrity enhancement feature and Advance data definition.
5. Advance SQl - Part III. Access Control.
6. Query-by-Example - Part I. Building query.
7. Query-by-Example - Part II. Selecting fields and rows.
8. Query-by-Example - Part III. Creating multy-table queris.

practical teaching

1. Objective of SQL. Terminology in SQL. Simple queries.
2. Sorting results (ORDER BY clause). Using the SQL aggregate functions. Grouping results (GROUP BY clause). Subqueries and multi-table queries. Creating, removing a table and index.
3. Creating and removing a View (CREATE VIEW, DROP VIEW). View resolution and updatability. Check options.
4. Some problems in databases check integrity. Integrity in CREATE TABLE and ALTER TABLE. Transactions.
5. Granting privileges to other users (GRANT). Revoking privileges from users (REVOKE).
6. Some practical rules in creating QBE.
7. QBE and selecting fields. Selecting rows using exact match criteria. Using like operator and wildcard characters. Using the AND operator and comparison operators. Using the OR and NOT operators.
8. QBE and manually place example elements. Automatically place example elements.

prerequisite

The basic course of SQL.

learning resources

All that is necessary is to be found on the Internet and is under the GPL.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 0; calculation tasks: 0; seminar works: 45; project design: 0; final exam: 50; requirements to take the exam (number of points): 50

references

Decision Theory

ID: PhD-3169
teaching professor: Misita Ž. Mirjana
ECTS credits: 5

goals

This PhD-level course on decision theory focuses on theories of individual and group decision making under risk and uncertainty. The course briefly explores utility theory under certainty and the notion of preferences and their representation, then progresses to the classic theories of decision under risk and uncertainty. Application Decision support Systems, Expert Systems, Knowledge-based systems in process of managerial decision making.

learning outcomes

Course issue is development student's skills in formulation, modeling, structuring and solving complex managerial problem, by himself or by computer support.

theoretical teaching

The course consists of three major sections: 1) modeling decisions, where the emphasis is on structuring decision problems using techniques such as influence diagrams and decision trees; 2) modeling uncertainty, which covers subjective probability assessment, the use of classical probability models, Bayesian analysis, and value of information; and 3) modeling preferences, which introduces the concepts of risk preference, expected utility, and multi-attribute value and utility models.

practical teaching

Design knowledge-based system for problem defined in doctoral thesis methodology.

prerequisite

Enrolled 1st semester of doctoral studies.

learning resources

On-line free academic access to electronic databases: ebesco, science-direct, emerald, etc. Computer classroom. Real practical example in pilot factory - access to real data and database in for purpose of solving real practical complex managerial problems.

number of hours

lectures: 35
research: 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: 80; final exam: 10; requirements to take the exam (number of points): 30

references

Maynard, H.B, , 1971, Industrial Engineering Hadbook, McGraw Hill, New York, third edition, pp.1532
Bazerman, M.H., Moore, D.A, 2008, Judgment in managerial decision making, 7th ed., John Wiley and Sons, pp.230.
Blake, C., 2008, The Art of Decisions: How to Manage in an Uncertain World, Prentice Hall, pp.232
Adair, J.E., 2009 Effective Decision Making: The Essential Guide to Thinking to Management Success, Pac Macmillan, pp.192.
Zeleny, M., 1982, Multiple criteria decision making, McGraw-Hill, New York.

Design of information systems

ID: PhD-3153
teaching professor: Milanović D. Dragan
ECTS credits: 5

goals

Acquisition of skills necessary for independent design or participation in the team for design of information systems.

learning outcomes

Students are expected to be able to apply the obtained knowledge for solving problems in design of information systems in companies.

theoretical teaching

1. Introduction into the design of information systems 2. CIM/CIB Computer-Integrated Manufacturing/Computer-Integrated Business as the goal of design of information systems 3. Structured Systems Analysis (SSA) 4. Object oriented analysis. Development of a conceptual model. Development of a sequence diagram. Development of completed class diagrams. Development of a state diagram. 6. Computer systems analysis 7. CASE-tools for systems analysis. Decomposition of computer systems 8. Methodology of design of information systems. Planning and phases. Defining the goal, analysis, global design of information systems. 9. Selection of hardware and software, detailed design of information systems 10. Introducing computers systems into work 11. Testing 12. Assessment of the designed solution and maintenance 13. Communications of factories of the future. Communications in complex companies. Electronic and mobile conducting of business 14. Project management. Standard software packages for project management

practical teaching

A case-study from the field of design of information systems.

prerequisite

learning resources

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 30; laboratory exercises: 0; calculation tasks: 0; seminar works: 0; project design: 25; final exam: 40; requirements to take the exam (number of points): 30

references

Milanović D. D., Misita M., Information systems for management and decision-making support, Faculty of Mechanical Engineering, Belgrade, 2008.
Turban E., Aronson E.J., Information technologies for management, Institute for textbook publishing and teaching aids, Belgrade, 2003.

Design of Steam Turbines

ID: PhD-3390
teaching professor: Petrović V. Milan
ECTS credits: 5

goals

1. The achievement of research and expert competence in the field of steam turbines.
2. The achievement of high level of theoretical knowledge
3. The acquisition of research and expert knowledge to design and optimize steam turbines.
4. The achievement of the techniques of process modeling.
5. Methods of experimental work in thermal power engineering.

learning outcomes

1. Expert and research deep knowledge of the thermodynamic cycle in steam turbines.
2. The development of critical thinking about energy use, fuel efficiency and environmental preservation
3. The ability of design of steam turbines.
4. Ability to use computer technology for modeling and calculations

theoretical teaching

Turbine aerodynamic design. 3D flow in steam turbines. Loss calculation. Optimal work factor and flow factor. Cascade design. Multistage steam turbines. Control stage design. HP-, IP-, LP-turbine flow path calculation. Steam turbine last stage design. Operating characteristics and off design behavior.
Project: Design of a Steam Turbine: Calculation of the main dimensions of a large steam turbine.

practical teaching

Project: Design of a Steam Turbine: Calculation of the main dimensions of a large steam turbine.

prerequisite

PhD student - Theraml power engineering

learning resources

Literature. Computing facility, software.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Petrovic, M.: Berechnung der Meridionalströmung in mehrstufigen Axialturbinen bei Nenn- und Teillastbetrieb, VDI-Verlag GmbH, Düsseldorf, 1995, 124 Seiten, ISBN 3-18-328007-8
Stojanovic, Themal Turbomachinery, Gradjevinska knjiga, Belgrade, 1967.
Traupel,W.: Thermische Turbomaschinen, Springer verlag, Berlin, 1982
A. Leizerovich: Steam Turbines for Modern Fossil-Fuel Power Plants
Lakshninarajana, B: Fluid Dynamics and Heat Transfer of Turbomachinery, Wiley, 1996,

Design of system mechatronics

ID: PhD-3030
teaching professor: Veg Đ. Aleksandar
ECTS credits: 5

goals

Quantum of knowledge acquired for a competent synthesis of the mechatronical composition, design of applied mechanism, selection of appropriate control unit and creation of flow-chart diagram. Engineering skill development to synthesize an optimal mechatronical solution to fulfil specified technical requirements.

learning outcomes

Achievment of the engineering experise in a true analysis of mechanisms, sensors, actuators and PLCs as a main componenets of a mechatronical system. Skillful approach to the direct design(synthesis) of an original mechatronical concept, involving real modules and elements.

theoretical teaching

System mechatronics. Examples. The genesis and development of mechatronics as a separate discipline. Need for mechatronic systems and patents in this field. The structure of mechatronic solutions. Analysis and synthesis of mechanisms. Encyclopedia of mechanisms. The selection of sensors according to technical requirements. The range, resolution, dynamics and the applicability. Output signals and conditioning. Multifactor optimization. The input-output structure of the PLC. The selection of the control processing unit, according to the structure of mechatronic solutions. PLC programming. Measuring circuit and control circuit executive PLC. Integration of PLC in mechatronic systems. Specifics of selection of optimal actuator. Controll of actuators. Making a diagram and connecting components in an integrated system. Testing of the system executive functions and settings for evaluation.

practical teaching

prerequisite

learning resources

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Digital Forensics

ID: PhD-3181
teaching professor: Mitrović B. Časlav
ECTS credits: 5

goals

The goal of this course is to familiarize PhD students with scientific methods for the identification, collection and analysis of data while preserving the original evidence and the chain of responsibility in the process of identifying potential digital evidence. Also, students will learn about the processes of collecting, preserving, analyzing and presenting digital evidence, as well as relevant forensic tools.

learning outcomes

Ability to contribute to scientific research. Student's ability to create and prepare scientific publications.. Ability to organize and control scientific projects. Students will focus on scholarly application of digital forensics.

theoretical teaching

1. The concept and development of digital forensics. Classification of forensic tools.
2. Analysis of forensic tools to implement and use areas.
3. Analysis of forensic tools to code and computing platform.
4. Forensic analysis tools used in different stages of the forensic investigation.
5. Forensic tool that analyzes the hardware.
6 Forensic tools that analyze code and programs.
7. Forensic tools that analyze operating systems and networks.

practical teaching

Students will become familiar with a number of forensic tools that will be applied in several case studies. The first case study is related to the analysis of hardware and restore data from damaged hardware. The second case study is related to the monitoring of the operating systems.

prerequisite

No preconditions.

learning resources

All necessary programs can be found under the GNU license.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 0; calculation tasks: 0; seminar works: 45; project design: 0; final exam: 50; requirements to take the exam (number of points): 50

references

Discrete Event Simulation

ID: PhD-3363
teaching professor: Babić R. Bojan
ECTS credits: 5

goals

This course deals with the technique of simulation for manufacturing systems modeling and analysis. Simulation is often used to support management and design decisions in complex production systems. All lectures will be given in a computer lab, where the corresponding production systems are modeled and the performance measures are analyzed using standard simulation software (AnyLogic). During the course, the students will work on several assignments and cases.

learning outcomes

After completing the course you should be able to:
• Understand the nature of discrete-event simulation and the types of simulation models
• Understand the broad applicability of discrete-event simulation to solve complex manufacturing systems problems
• Learn the essential steps of the simulation methodology
• Learn analytical techniques for interpreting input data and output results pertinent to simulation models
• Learn to use the AnyLogic Simulation Software Tool to build credible valid simulation models, design and run simulation experiments, and critically evaluate decision-support simulation results
• Gain insight into system behavior by measuring the performance characteristics of proposed new manufacturing system or the impact of proposed changes for existing manufacturing system

theoretical teaching

Introduction to Manufacturing Systems Simulation
Discrete-Event Modeling and Simulation of Detailed Manufacturing Operations
Input Data Analysis for Modeling and Simulation
Product Mix Modeling
Transporter, and Conveyor Modeling
Statistical Analysis of Simulation Output
Design of Simulation Experiments, Verification and Validation
Simulation Optimization
Agent based Simulation
Distributed Manufacturing Enterprise Simulation

practical teaching

(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) B. Babic, Handouts, University of Belgrade, Faculty of Mechanical Engineering, 2011, 18.1
(3) B. Babic, Distance learning Website (http://147.91.26.15/moodle/), University of Belgrade, Faculty of Mechanical Engineering, 2012, 18.13
(4) AnyLogic simulation software

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) B. Babic, Handouts, University of Belgrade, Faculty of Mechanical Engineering, 2011, 18.1
(3) B. Babic, Distance learning Website (http://147.91.26.15/moodle/), University of Belgrade, Faculty of Mechanical Engineering, 2012, 18.13
(4) AnyLogic simulation software

number of hours

lectures: 35
research: 0

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.

District heating

ID: PhD-3073
teaching professor: Živković D. Branislav
ECTS credits: 5

goals

Capacity development for the individual and team work in the field of district heating. Development and synthesis of complex technical solutions,related to the Ph.D dissertation.

learning outcomes

PhD student who listenes to and passes this subject is capable to independently observe, formulate and solve problems using modern methods, independently and in a team organize and conduct research, makes objective conclusions and to suggest appropriate solutions in the field of district heating.

theoretical teaching

User heat demands profile during the heating season and its coupling with a heat source, especially in the case of combined production of electricity and heat. Possibilities and limitations of central control in the hot water heating from a centralized heat plant. Primary and secondary water temperature changes (sliding diagrams)for direct and indirect connection. Distribution of heat in district heating systems: piping, networks, connections. Heat losses during transport of fluid. Networks balancing. Selection of the optimal fuel in a heat plant. The use of waste heat in district heating systems. District cooling. Economic and environmental performance indicators of district heating systems.

practical teaching

-

prerequisite

There are no requirements

learning resources

-

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

ASHRAE Handbook - HVAC Applications, ASHRAE Publication Sales, Tullic Circle NE, Atlanta Georgia 2011
ASHRAE Handbook - HVAC Systems and Equipment, ASHRAE Publication Sales, Atlanta Georgia 2008
Fox, J. A.: Hydraulic analysis of unsteady flow in pipe networks, John Wiley and Sons, New York, 1977
Scientific and technical papers related to the specific topics

District Heating

ID: PhD-3397
teaching professor: Živković D. Branislav
ECTS credits: 5

goals

Capacity development for the individual and team work in the field of district heating. Development and synthesis of complex technical solutions,related to the Ph.D dissertation.

learning outcomes

PhD student who listenes to and passes this subject is capable to independently observe, formulate and solve problems using modern methods, independently and in a team organize and conduct research, makes objective conclusions and to suggest appropriate solutions in the field of district heating.

theoretical teaching

User heat demands profile during the heating season and its coupling with a heat source, especially in the case of combined production of electricity and heat. Possibilities and limitations of central control in the hot water heating from a centralized heat plant. Primary and secondary water temperature changes (sliding diagrams)for direct and indirect connection. Distribution of heat in district heating systems: piping, networks, connections. Heat losses during transport of fluid. Networks balancing. Selection of the optimal fuel in a heat plant. The use of waste heat in district heating systems. District cooling. Economic and environmental performance indicators of district heating systems.

practical teaching

-

prerequisite

There are no requirements

learning resources

-

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

ASHRAE Handbook - HVAC Applications, ASHRAE Publication Sales, Tullic Circle NE, Atlanta Georgia 2011
ASHRAE Handbook - HVAC Systems and Equipment, ASHRAE Publication Sales, Atlanta Georgia 2008
Fox, J. A.: Hydraulic analysis of unsteady flow in pipe networks, John Wiley and Sons, New York, 1977
Scientific and technical papers related to the specific topics

Dynamic problems of rail vehicles

ID: PhD-3252
teaching professor: Simić Ž. Goran
ECTS credits: 5

goals

1. Deepening of knowledge in different areas of the dynamic behavior of railway vehicles.
2. Become acquainted with advanced methods and tools for the study of the dynamic behavior of railway vehicles.
3. Training for participation in research and development teams on the projects in the field of rail vehicle dynamics.

learning outcomes

After completion of the course a PhD student should be able to:

1. apply advanced computational methods and computer tools in calculation of various parameters of the railway vehicle dynamic behavior.
2. analyze specific dynamic phenomena for the movement of rail vehicles.
3. participates in defining the research program of dynamic problems of rail vehicles.
4. participate in the critical evaluation of research results.
5. participates in drawing conclusions about the quality of the research results
6. participate in proposing future research directions of specific dynamic behavior problems of the railway vehicles.

theoretical teaching

Depending on PhD. thesis field following subjects will be more or less deeply studied.
Non linear modeling of the rail vehicles dynamic behaviour. Multibody simulation tools. Eigenbehaviour. Vehicle elastic body vibrations. Statistical methods for description of geometrical deviations of the track. Non-linear contact geometry. Methods for determination of the equivalent conicity. Counterformal and conformal wheel-rail contact. Non-liner wheel-rail contact models. Kalkers contact theories. Stability of motion. Critical speed. Hunting limit-cycle determination using simulation models. Non-linear curving models. Wheel-rail wear assessment criteria. Advanced assessment criteria of the dinamic behavior of rail vehicles: safety against derailment, track shift force, stability, ride characteristic, track loadings, ride comfort. Advanced tools in dynamic test result analysis. Longitudinal train dynamics. Noise sources and noise abatment methods. Interior and outside noise emmision.

practical teaching

Student makes seminar paper from a selected area upon agreement with relevant teacher and mentor of doctoral dissertation.

prerequisite

Previous knowledge of the railway vehicles design at the master course level. Previously completed course of the dynamics at the master level.

learning resources

Milutinović, D., Simić, G, Opterećenja i proračun točkova železničkih vozila, Mašinski fakultet, Beograd 2006.

SCI list publications

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Knothe, K., Stichel, S, Schienefahrzeugdynamik, Springer Verlag,Berlin, 2003
Shabana, A., Zaazaa,K., Sugiyama,H., Railroadvehicle Dznamics, A Computational Approach, CRC Press,Boca Raton, 2007
Iwnicki, S., Handbook of Railway Vehicle Dynamics, CRC Press, Boca Raton, 2006
Garg,V., Dukkipati, R., Dynamic of Railway Vehicle Systems, Academic Press, 1984

Dynamics and Strength of Mining and Construction Machines

ID: PhD-3020
teaching professor: Bošnjak M. Srđan
ECTS credits: 5

goals

Basic course goals: 1) introducing students with specificities of dynamic processes of construction and mining machines; 2) introducing students with problems of strength of of construction and mining machines substructures; 3) mastering practical skills which are necessary for analysis of dynamic behavior and strength of construction and mining machines.

learning outcomes

Mastering the curriculum student gains: 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 dynamics and strength).

theoretical teaching

Basic excavating machines dynamics – backhoe excavators and bulldozers. Dynamics of raw material fragmenting and sorting machines – crushers and screening machines. Dynamics and strength of machines for continuous excavation.

practical teaching

Dynamic models of single bucket excavator excavating devices. Impact of Bulldozer to the obstacle. Calculation of basic parameters of crushing and screening machines. Bucket wheel excavators and trenchers excitation modeling (determination). Analysis of bucket wheel excavators' and spreaders' structure response on excitation caused by external excitation. Consultations.

prerequisite

Required previously passed courses: Numerical methods, Vibrations of mechanical systems, Structural Analysis of Material Handling Machines

learning resources

1. Computers, Laboratory 516
2. Software Matlab, Catia

number of hours

lectures: 35
research: 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

Srđan Bošnjak, Bucket Wheel Trenchers, University of Belgrade, Faculty of Mechanical Engineering, Belgrade, 2001.
Durst W, Vogt, W. Bucket Wheel Excavator. Clausthal-Zellerfeld: Trans Tech Publications; 1989.
Волков, Д. П., Черкасов, В. А.: Динамика и прочност многоковшовых экскаваторов и отвалообрзователей, Машиностроение, Москва, 1969.

Dynamics of a system of rigid bodies

ID: PhD-3122
teaching professor: Lazarević P. Mihailo
ECTS credits: 5

goals

To introduce students to fundamentals of system of rigid bodies,(SRB). It is possible to solve direct and inverse kinematics and dynamics task of (SRB) using the classical approach as well as modern theory of finite rotation and quaternions. Determination of the (simulation) models SRB-differential equations of motion SRB which are important in practical problems of dynamics of SRB.

learning outcomes

Attending the course students acquire the ability to analyze problems and synthesis solutions to the problem of rigid body dynamics system with the use of scientific methods and procedures as well as computer technology and equipment. Enabled him to connect knowledge of mechanics, mathematics, physics, the practical application of solving current problems of rigid body dynamics system.

theoretical teaching

Introduction to dynamics of system of rigid bodies (SRB). Fundamentals of kinematic chains.Orthogonal transformation of coordinates (OTC). Basic theory of finite rotations (FROT). FROT and spherical motion of rigid body. Quaternions. Hamilton-Rodriguez (HG) parameters. The transformation matrix in case of rotation in regard to (HG parameters and quaternions` notation), the application of the spherical motion SRB. Dynamics of spherical motion of the rigid body.The first integrals of differential equations (DIFE)of spherical motion of rigid body. Constraints of system, ideal and real constraints. The kinetic energy of the system of the rigid bodies.Metric tensor of system. Generalized forces and the principle of ideality RS- different cases -specially conservative case. The case of real constraints.
(DIFE) of motion of the RS in (contra)covariant form,quaternion form. DIFE of motion of RS given in the form of kinematic chain with the structure of topological three; DIFE of motion of RS given in the form of closed-kinematic chain.Additional equations of contraints. Optimal motion of system of rigid bodies. Variational approach.
Maximum-principle-application to real systems.
Fundamentals of system dynamics of deformable bodies and contact mechanics.

practical teaching

Examples of determining the OTC. Determining the number of degrees of freedom for a given SRB. Application of Rodriguez matrix transformation-typical cases. An example of determining the configuration of a case of SRB-an industrial machine. Examples of application of the finite rotation and quaternions in spherical rigid body motion. Instances of the spherical rigid body motion-typical cases. Determination of the kinetic energy of the system of rigid bodies as well as the metric tensor of SRB. Application on a concrete example: a mechanical model of washing machines and robot Neuroarm as SRB. An instance of the formation of (contravariant)covariant forms of motion given SRB with 4-6 degrees of freedom. Synthesis of optimal control SRB.

prerequisite

none

learning resources

1.Wittenburg J.,Dynamics of Systems of Rigid Bodies,Teubner,Stuttgart,1977.(KSJ)
2.Čović M. V. Lazarević, Mechanics of Robot, MF Belgrade,2009.(Book)
3.Lazarević M. Exercises in mechanics of robot, MF Belgrade,2006.(ZZD)
4.Shabana A. Dynamics of Multibody Systems,2005.(KSJ)
5.Written abstracts from the lectures (Handouts)
6.Cyberbotics Webots - software package
7.Laboratory model of washing machine-4DOFs.
8.NeuroArm-laboratory robot-7 DOFs.
9.SimMechanics,GUI,(CSP)

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

Pfeiffer, F., Mechanical System Dynamics,Springer-Verlag Berlin Heidelberg,2008.
Ahmed A. Shabana,Computational Dynamics,John Wiley & Sons, Inc., 605 Third Avenue, New York, NY,2001
Coutinho, M., Dynamic Simulation of Multibody Systems, Birkäuser, 2001.
Schielen,W. ed., Multibody Systems Handbook, Springer-Verlag, Berlin, 1990
Roberson, R.E., Schwertassek, R., Dynamics of Multibody Systems, Springer-Verlag, Berlin, 1988.

Dynamics of material handling and conveying machines

ID: PhD-3079
teaching professor: Zrnić Đ. Nenad
ECTS credits: 5

goals

The main objective of this course is to achieve competence of PhD students to master the principles of analysis dynamic behavior of support structures of material handling machines and conveyors and that is able to be incorporated into complex processes of their behavior under the action of various external loads.

learning outcomes

Mastering the curriculum PhD students obtain general abilities that can be applied in Research & Development of material handling and conveying machines: set up discrete e and continual models of the machine support structure, defining its natural frequencies by using Finite Element Method, analysis of external loads (excitation), evaluation of set up model, obtaining response of dynamic system to external excitation, capacity of analyzing alternative solutions in the modeling process, developing skills in presentation of research results.

theoretical teaching

Introduction into dynamics of material handling and conveying machines. Modeling support structure of a machine and drive units. Dynamic factors according to the existing standards. Discrete and continual models. Analysis of external loads (excitation). Obtaining natural frequencies of support structure of a material handling machine or conveyor by using Finite Elements Method. Effects of moving load on dynamic behavior. Moving load models: moving force, moving mass, moving oscillator. Wind effects on dynamics of structures. Obtaining dynamic response of the support structures of material handling and conveying machines. Analysis of obtained results. Evaluation of models. Comparison between various modeling approaches on dynamic response of a structure.

practical teaching

Preparing a seminar work which should be a basis for publication of the research paper in the publication, such as international conference or scientific journal.
1. Introduction
2. Set up of the problem
3. Method of problem solving
4. Analysis of the obtained results and discussion
5. Conclusion
6. References

prerequisite

The conditions are defined by the curriculum of the study program.

learning resources

1. Nenad Zrnić: Dynamics of ship-to-shore container cranes, Zadužbina Andrejević, 2006.
2. Davor Ostrić: Dynamics of bridge cranes, Faculty of Mechanical Engineering Belgrade, 1998.
3. Milosav Georgijević: Dynamics of cranes, experimental and model analysis, Zadužbina Andrejević, 1996.

radić Mijaliović, Zoran Marinković, Miomir Jovanović: Dynamics and optimization of cranes, Faculty of Mechanical Engineering Niš, 2000.
5. Computers, Laboratory 516, ICT / CAH
6. KRASTA software package - program for statical and modal analysis of spatial frames, BSB Kühne GmbH, ICT / CSP.
7. Software SAP 2000 - program for statical and modal analysis of spatial frames.

number of hours

lectures: 35
research: 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

J. Verschoof : Cranes – Design, Practice, and Maintenance, Professional Engineering, 2002.
L. Fryba: Vibrations of solids and structures under moving loads, Thomas Telford, 1999.
Proceedings of the International Conferences on Material Handling, Constructions and Logistics, 2006, 2009, 2012

Econometric methods

ID: PhD-3155
teaching professor: Milanović LJ. Dragan
ECTS credits: 5

goals

The goal of course is to master the basics of econometric modeling and the main techniques of analysis, hypothesis testing, and evidence of working with economic data. Through lectures and practical classes, the goal is for students to master the econometric theory.

learning outcomes

Students need to gain insight into a wide range of applications of econometric methods and models in different areas and preparing students for their application.
Students are expected to fully master the econometric technique, based on the models of mathematical economics, statistical inference and econometrics methods.

theoretical teaching

Subject of econometrics.The methodology of econometric research.Linear regression models (LRM).The method of least squares (MLS). LRM with two variables.Parameter estimation using MLS. Statistical tests.Confidence intervals for the parameters of LRM.Predictions.The reduction of some non-linear to linear model.LRM with multiple variables.Heteroscedasticity. Auto correlation. General MLS. The method of simultaneous equations. Parameter estimation by indirect MLS. Parameter estimation of the two-stage MLS. Time series.Component of the time series. Analytical methods for determining the trend.

practical teaching

Practical training consists of seminar tasks and solving computing problems of the above teaching units.

prerequisite

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

learning resources

1. Handouts,
2. Jovicic M: Econometric methods, EF, Belgrade, 2002 (in Serbian)

number of hours

lectures: 35
research: 0

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

Mladenović Z and Petrović P: Introduction to Econometrics, EF, Belgrade, 2007 (in Serbian)
Greene W H: Econometric Analysis (6th International Edition), Prentice Hall, 2007.
Gujarati : Basic Econometrics (5th edition), McGraw Hill, 2009.
Kennedy P: A Guide to Econometrics (6th Edition), Wiley-Blackwell, 2008.
Mladenović Z: Collection of solved problems in econometrics, EF, Belgrade, 2002 (in Serbian)

Efficiency and reliability of weapon

ID: PhD-3156
teaching professor: Milinović P. Momčilo
ECTS credits: 5

goals

The basic goals of subject is to developed applied knowledge of weapon quality estimations and criteria for weapon evaluation, regarding their performances integrated in to the different conditions of Military employment.The system knowledge circled technical, ethnology and functional performances as relations integrated with theoretical and experimental statistics and probability modeling as the goal of subject skills .Education provides knowledge of weapon functionality, handling maintaining and warehousing as total quality inerrable conditions for their purpose measurement during tactical and design exploitation.Also coast effective analyses regarding weapon performances are included as measure for weapon comparing in preliminary study of design and-or their procurement.War game conditions with variable extreme performances exposing, have been estimated mathematically.Risk functions of weapon use is the subject of theoretical modeling.Overall goal is to provide mathematical and theoretical tool for final tactical and technical integrated design of weapon and weapon systems.

learning outcomes

Applicant (student),achieved knowledge of so called external functional design of weapon .Also,achieved knowledge about integration of different technical and technology performances of weapon in to the joint quality weapon systems performances valid for combat employment.This is estimated by random arguments probability functions of efficiency , reliability,hazard risk, coast effective ,adaptability etc.This is the base for the organization and estimation of weapon units in organizational systems of systems at the further weapon commissioners.

theoretical teaching

Theoretical approach generally considering,
-categorization of the weapons types, applicants for military organizational systems integrations
- structure of reliability function applied on to the different weapon subsystems
- efficiency and effectiveness criteria measurements and theoretical and experimental estimations
- Theoretical criteria of war game equations and tactical and technical requirements modeling of weapon systems
- technical integration of military units and their joint weapon efficiency
- weapon platforms adaptability for reliable and efficiency design of weapon systems
- Equipment of weapon and their reliable and efficiency design
- military handling,maintaining,supply and procurement functions, in logistics and battle field using

practical teaching

-Single weapon simulation function
-joint weapon simulation functions of probability and reliability
-Weapon and equipment integrated on the Platforms and accordance with efficiency and reliability
-Combat Military units war game modeling to efficiency and reliability of weapon and

platforms

prerequisite

-Consultative ,based on groups of lessons and practical consultations about seminar papers with selected types of weapon and combat platforms

learning resources

-Software and Computers
-Simulation laboratories
-External military proving ground laboratories in contract school deals of using

number of hours

lectures: 35
research: 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: 90; project design: 0; final exam: 0; requirements to take the exam (number of points): 10

references

P.Przemensky, Mathematical modeling in defence analises ,AIAA EducatinS. ,2005
E.J.Eichblatt, Test and evaluation of tactical missile, AIAA ,V 119 ,Progres in AA ,2001

Electronically controlled systems of motor vehicles

ID: PhD-3002
teaching professor: Aleksendrić S. Dragan
ECTS credits: 5

goals

The basic goal is research and development in the area of electronically controlled systems of motor vehicles.

learning outcomes

Development of students' abilities for conducting scientific research in the area of electronically controlled systems of motor vehicles.

theoretical teaching

Lectures are based on consultation with students in accordance with the previously issued research tasks.

practical teaching

Practical lectures will be coordinated with the students research tasks.

prerequisite

There is no precondition.

learning resources

Pacejka H.B. Tyre and vehicle dynamics, Butterworth-Heinemann, 2002.
Heisler H. Advanced vehicle technology, Butterworth-Heinemann, 2002.
Dhameja S. Electric vehicle battery systems,Butterworth-Heinemann, 2002.
Larminie J., Lowry J. Electric vehicle technology explained, John Wiley & Sons,2003.

number of hours

lectures: 35
research: 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

Electronic circuits and systems

ID: PhD-3102
teaching professor: Kandić B. Dragan
ECTS credits: 5

goals

More detailed familiarization with electronics and developing competence in further development of academic knowledge and practical skills in scientific, professional and applied areas of mechanical engineering relying on electronics. More detailed familiarization with electronic devices and circuits and overview of contemporary methods and software tools for their analysis, simulation and design.

learning outcomes

Having successfully mastered teaching contents of electronic circuits and systems, student acquires ability to qualitatively pursue his scientific and professional career. He can manipulate methods of analysis and measurements in electronic circuits anticipating the solutions and perceiving outcomes. Student gains deeper insight into research and practical methods in the fields he can adequately apply in the concrete problem solving in mechanical engineering.

theoretical teaching

-Brief historical overview and future trends in electronics. Electronic devices, circuits and systems. Signals and spectra.
-Survey of contemporary high-end software for modelling, simulation and design of electronic circuits.
-Fundamental theorems of electric/electronic circuits and networks. Syntesis principles of active and passive, balanced and grounded one- and multiport networks.
-Ideal and real amplifiers (physical realizability, transfer-functions, equivalent circuits, frequency-characteristics, stability criteria, feedback). Multistage amplifiers.
-Semiconductors (structure, intrinsic and extrinsic, transport phenomena). -PN-junction (physics, modes of operation, depletion layer and diffusion capacitances, voltage breakdown, temperature effects).
-Semiconductor diodes (current-voltage characteristics, models for small and large signals, analysis of diode circuits with RLC elements, application in linear and nonlinear signal processing, switching operation). Special purpose diodes (Zener, photodiodes and solar cells, LED, varicap, Schottky, tunnel, PIN).
-Bipolar and unipolar transistors (physics, biasing, operation modes, types, large-signal models, characterics, models for small-signal operation at low- and high- frequencies, basic configurations, breakdown, switching operation).
-Power amplifiers.
-Selected topics of power electronics.
-Operational amplifiers (types, properties, selected applications in linear and nonlinear signal processing). Electric filters.
-Gyrators. Positive and negative immitance convertors and inverters and their application in network synthesis.
-Oscillators.
-Signal conditioning. Examples with selected types of sensors (for strain, force, torque, displacement, ...).
- A/D and D/A converters. Selected topics in digital electronics.

practical teaching

Auditorial exercises involve presentation of numerical examples and problems, all in compliance with theoretical teaching. In laboratory exercises the students work with electronic devices and instrumentation, and intensively apply LT Spice IV, LogiSim and student version of Multisim to the purpose of experimental verification of functioning of selected electronic circuits presented in auditorial exercises.

prerequisite

Higher course of mathematics and the course of Numerical methods (mandatory courses on Ph. D. studies at Faculty of mechanical engineering).

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, Faculty of technical sciences, Novi Sad, 2004 /In Serbian/, ISBN 86-85211-16-6
3. M. Živanov: Electronics fundamantals-amplifier circuits, Faculty of technical sciences, Novi Sad, 2004, /In Serbian/, ISBN 86-85211-02-6
4. V. Drndarević: Electronics, Faculty of transport and traffic engineering, Belgrade, 2005 /In Serbian/, ISBN 86-7395-181-X
5. M. Živanov: Electronics fundamentals-Exercises, Faculty of technical sciences, Novi Sad, 2004 /In Serbian/, ISBN 86-85211-17-4
6. D. Stanković: Physical/technical measurements (sensors), University of Belgrade, 1997 /In Serbian/, ISBN 86-81019-58-9
7. Licensed software, LT Spice IV, LogiSim and other student-version software.

number of hours

lectures: 35
research: 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: 45; project design: 0; final exam: 45; requirements to take the exam (number of points): 50

references

A. Sedra, K. C. Smith: Microelectronic circuits, 6th Edition, Oxford University Press, NY, 2011, ISBN 978-019-973851-9.
K. Brennan, A. Brown , Theory of Modern Electronic Semiconductor Devices, J. Wiley, New York, 2002, ISBN 0-471-41541-3
P. Horowitz, W. Hill, The Art of Electronics, Cambridge University Press, New York, 1994, ISBN 0-521 -37095-7
R. Boylestad, L. Nashelsky: Electronic devices and circuit theory, 10th Edition, Prentice Hall, NY, 2009, ISBN 978-0-13-606463-3.4
T. L. Floyd: Electronic devices, 8th Edition, Prentice Hall, NY, 2008, ISBN 978-0-13-615581-2.

Energy and environment

ID: PhD-3097
teaching professor: Jovović M. Aleksandar
ECTS credits: 5

goals

The aim of this course is to cover important energy-related problems with considerable impact to the environment, by implementation of appropriate scientific methods. The subject is designed as an introductory course in the field of environmental engineering on PhD level. The key issues are effective and environmental friendly obtaining, exploration and conversion of energy resources, likewise distribution, transport and end-use of energy in different sectors.

learning outcomes

After completing the course, candidate will master with basic knowledge that concerns the analysis and evaluation of scientific work, fundamentals of experimental methods, modeling the energy facilities influence on environment and global climate change, as well as definition of the influenced parameters, modeling and optimization of energy facilities with regard to increasing the energy efficiency.

theoretical teaching

Introduction. Energy and its usage and consumption in industrialized society. Sustainability in energy sector. Traditional knowledge on energy and its environmental impact (fossil fuels - oil, coal, natural gas, renewable energy sources - solar, wind energy, hydro energy, biomass, geothermal energy, etc.). Heat machines. CHP plants. Possibilities and obstacles for nuclear energy. Energy savings. Rational usage of energy in industry, households and agriculture. Transportation. Air pollution and climate change. Global effects. Climate change, GHG gasses, ozone layer depletion.

practical teaching

Preparation of energy audit questionnaire. Determination of Energy Cost Centers (ECC) within Energy Audit. Planning and preparation of measurement schemes of key parameters for material and energy balances within ECC as well as utility services in company. Implementation of energy audit in real industrial companies. Energy and material balances. Proposition of the list of energy efficiency measures. Calculation of energy savings for each proposed measure. Feasibility study and techno-economic analysis of proposed measures. Energy audit report. Presentation of energy audit results.

prerequisite

There is no previous requirements for attending this course.

learning resources

Laboratory and computational equipment

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 15; calculation tasks: 0; seminar works: 80; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Ristinen, R., Kraushaar, J., Energy and Environment, John Wiley and Sons, 1999., ISBN 0-471-17248-0
Boyle, G., Everett, B., Ramage, J., Energy Systems and Sustainability, Block I, Oxford University Press, 2003., ISBN 0-19-926179-2
Nazaroff, W., Environmental Engineering Science, John Wiley and Sons, 2001., ISBN 0-471-14494-0
Kiely, G., Environmental engineering, McGraw-Hill, 1998., ISBN 0-07-709127-2
Jankes, G., Stamenić, M., et al.: Manual for energy efficiency improvements and energy conservation in industry, Faculty of Mechanical Engineering, Belgrade, 2009. ISBN 978-86-7083-680-8

Energy efficiency in buildings

ID: PhD-3074
teaching professor: Živković D. Branislav
ECTS credits: 5

goals

Capacity development for the individual and team work in the field of energy efficiency in buildings. Development and synthesis of complex technical solutions,related to the Ph.D dissertation

learning outcomes

PhD student who listenes to and passes this subject is capable to independently observe, formulate and solve problems using modern methods, independently and in a team organize and conduct research, makes objective conclusions and to suggest appropriate solutions in the field of energy efficiency in buildings.

theoretical teaching

Basis of efficient energy use in buildings. Integrated approach to designing buildings. Thermal characteristics of the building envelope. Heat transfer through the building structure. Thermal insulation. Windows, heat gains from Solar radiation, daylighting in flats. HVAC equipment in buildings: boilers, domestic hot water boilers, chillers, heat pumps, air handling units, equipment for the use of waste heat from HVAC systems. Mmeasurement and control of HVAC systems. Local controland central systems for buisding energy monitoring and control. Energy policy, energy costs, tariff systems, the motivation of users to save energy. Maintenance of HVAC systems in buildings. Energy efficient use of HVAC equipment.

practical teaching

-

prerequisite

There are no requirements

learning resources

-

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

ASHRAE Handbook - Fundamentals, ASHRAE Publication Sales, Tullic Circle NE, Atlanta Georgia 2009
ASHRAE Handbook - HVAC Applications, ASHRAE Publication Sales, Tullic Circle NE, Atlanta Georgia 2011
ASHRAE Handbook - HVAC Systems and Equipment, ASHRAE Publication Sales, Atlanta Georgia 2008
Sherrat, A.F.C: Air Conditioning System Design for Buildings, London, My Grow-Hill, 1984
Turner, W.C.: Energy menagement handbook, Fairmount Press, Lilburn, GA, 2001

Energy Efficiency in Buildings

ID: PhD-3394
teaching professor: Živković D. Branislav
ECTS credits: 5

goals

Capacity development for the individual and team work in the field of energy efficiency in buildings. Development and synthesis of complex technical solutions,related to the Ph.D dissertation

learning outcomes

PhD student who listenes to and passes this subject is capable to independently observe, formulate and solve problems using modern methods, independently and in a team organize and conduct research, makes objective conclusions and to suggest appropriate solutions in the field of energy efficiency in buildings.

theoretical teaching

Basis of efficient energy use in buildings. Integrated approach to designing buildings. Thermal characteristics of the building envelope. Heat transfer through the building structure. Thermal insulation. Windows, heat gains from Solar radiation, daylighting in flats. HVAC equipment in buildings: boilers, domestic hot water boilers, chillers, heat pumps, air handling units, equipment for the use of waste heat from HVAC systems. Mmeasurement and control of HVAC systems. Local controland central systems for buisding energy monitoring and control. Energy policy, energy costs, tariff systems, the motivation of users to save energy. Maintenance of HVAC systems in buildings. Energy efficient use of HVAC equipment.

practical teaching

-

prerequisite

There are no requirements

learning resources

-

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

ASHRAE Handbook - Fundamentals, ASHRAE Publication Sales, Tullic Circle NE, Atlanta Georgia 2009
ASHRAE Handbook - HVAC Applications, ASHRAE Publication Sales, Tullic Circle NE, Atlanta Georgia 2011
ASHRAE Handbook - HVAC Systems and Equipment, ASHRAE Publication Sales, Atlanta Georgia 2008
Sherrat, A.F.C: Air Conditioning System Design for Buildings, London, My Grow-Hill, 1984
Turner, W.C.: Energy menagement handbook, Fairmount Press, Lilburn, GA, 2001

Engineering Design Methodology

ID: PhD-3343
teaching professor: Ognjanović B. Milosav
ECTS credits: 5

goals

Mastery of scientific methods for understanding of the process of knowledge transformation in technical system, of scientific methods for this methodology development, creative skills development for application of knowledge and information data. The study of the methodology of new products development, trends and tendencies of technical systems development in the future.

learning outcomes

PhD student introduced into research of methods for the new products development, ie. new technical systems development for the future. Introduced in a new area of propulsion research and development of methodology for encouraging creativity in the development of new technical systems.

theoretical teaching

Aspects of product development (technical, social, economic, ecological and aesthetic). Philosophy and vision in the development of products for mechanical engineering. Methodologies and tools in product development. Approaches in product development in engineering design and in industrial design (integrated, simultaneous, multi-disciplinary, collaborative, axiomatic, empirical, robust, virtual, ...). Creativity in product development and design, innovativeness. Knowledge engineering, information systems and decision-making in product development and design. Calculations, simulations, experiments (modeling, model production, 3D scanning and printing, virtual reality, testing of structures and components). Limitations and constraints in product development (user needs, technology needs, reliability and safety in operation, vibration, noise, ... - Design for Reliability, Design for Vibration and Noise, Design for Cost, Design for Quality, Design for User,. ...). Harmonization of requirements, constraints, properties and the environment (living and working environment).

practical teaching

Research processes, methods and tools for use in developing of new products i.e. new technical systems. Development of creativity oriented towards the development of new technical systems. Preparation and defense of the seminar work.

prerequisite

It is no conditions for subject attending.

learning resources

Laboratory for Engineering Design LECAD. Journals and conferences proceedings from key conferences in this field. Software for modeling and product development. 3D printer, etc..

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Pahl G., Beitz W.: Engineering Design – A Systematic Approach, Springer-Verlag, 1991.
Hubka V., Eder E.: Design Science – Introduction to the Needs, Scope and Organization of Engineering Design Knowledge, -Springer 1995.
Hales C., Gooch S.: Managing Engineering Design, Springer-Verlag London 2004.
Debenham J.: Knowledge Engineering, - Springer-Verlag 1998
Frankenberger E., Badke-Schaub P., Birkhofer H. (editors): Designers The Key to Successful Product Development, -Springer 1998

Engineering Management

ID: PhD-3348
teaching professor: Spasojević-Brkić K. Vesna
ECTS credits: 5

goals

The objective of this course is to examine issues relevant to growing technology businesses, developing products, improving processes, and leading technology based organizations. This course provides the learning base on which competence for a professional scientific engineering career can be built, as both engineering and management aspects of engineering, and their integration are covered. Through this course students are trained for self-use of engineering management tools and for self-development of new models and improvement of existing models in the field, so that they can navigate in increasingly complex and uncertain business environment and survey it.

learning outcomes

By completing the programm of this course students acquire following professional skills:
1. Basic understanding of various dimensions and functions of the broad field of engineering management.
2. Analytical skills needed to tackle the ever-changing problems and situations of modern competitive production systems.
3. Conceptual and reasoning skills with appropriate decision support methods and tools used in production management.
4. Modelling of contingency differences effects on the organizational design.
5. Understanding and modelling of the need for and requirements on sustainable and efficient production processes.

theoretical teaching

1. Introduction to Management and Organization
2. Organizational Structure and Design Principles
3. Organizational Design Models
4. Production Planning and Control. Methods and techniques.
5. Supply Chain Management. Inventory Management.Just-In-Time concept.
5. Human Resources Management. Structuring high performanse work arrangements.
6. Quality Management. Quality Tools.
7. Maintenance Management. Reliability and Risk.
8. Financial Management. financial Analysis and Forcasting.
9. Business performances.

practical teaching

Case studies in the field of theory. Tools, methods and techniques implementation. Modelling of real industrial examples.Practical part of this course will help students in three ways: firstly, by providing a framework for managing individual and group performance; second, developing understanding of the leadership required manage the behaviour of people in organisations; and third, exploring the usefulness of the concepts and management practices discussed and used in case studies.

prerequisite

Enrolled semester.

learning resources

1. C. M. Chang, Ching Ming Chang,Engineering management: challenges in the new millennium, Pearson Prentice Hall, 2005
2. Cole G. A, Management - Theory and Practice, Letts Educational,London, 2000.
3. W. Dale Compton, Engineering management: creating and managing world-class operations, Prentice Hall, 1997.
4. Tersine R.J., Production/Operations Management:Concepts, Structure and Analysis, Prentice Hall, 1985
5. John S. Oakland, Total Quality Management:Text with Cases, Elsevier Science & Technology, 2000
6. Slides from Lectures
7. Scientific papers from Scopus, Science Direct and other databases.

number of hours

lectures: 35
research: 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: 0; project design: 50; final exam: 50; requirements to take the exam (number of points): 25

references

C. M. Chang, Ching Ming Chang,Engineering management: challenges in the new millennium, Pearson Prentice Hall, 2005
Cole G. A, Management - Theory and Practice, Letts Educational,London, 2000.
W. Dale Compton, Engineering management: creating and managing world-class operations, Prentice Hall, 1997.
Tersine R.J., Production/Operations Management:Concepts, Structure and Analysis, Prentice Hall, 1985
John S. Oakland, Total Quality Management:Text with Cases, Elsevier Science & Technology, 2000

Environmental aspects of combustion

ID: PhD-3273
teaching professor: Stojiljković D. Dragoslava
ECTS credits: 5

goals

Introduction to the issues and methods for reduction of environmental pollution from the combustion process.

learning outcomes

Acquisition of basic knowledge about the problems of environmental pollution from the combustion process and methods for pollution reduction.

theoretical teaching

Calculation of the quantity and composition of the flue gas at different stages and for different types of fuel. Classification of the flue gases by criteria of complete combustion and toxicity - impacts on the environment. The gaseous products of combustion - formation mechanisms, the impact on the combustion process, the impact on equipment / machinery, the options for reduction (considering the mechanisms of condensation, adsorption, gas-solid and gas-liquid absorption). Methods and procedures for reduction of of sulfur and nitrogen compounds emissions. Solid particles - mechanisms of origin, impact and possibilities of flue gas cleaning.

practical teaching

Depending on defined topics of doctoral thesis the appropriate program of experimental work on the thesis is adopted.

prerequisite

none

learning resources

Laboratory facility / installation / machine (LPI):
1. Laboratory facility for investigation of the solid fuels
combustion
Laboratory equipment for testing the fuels:
1. Various instruments for testing physical and chemical characteristics of solid and liquid fuels.
and other facilities and installations as needed

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Joseph P. Reynolds, John S. Jeris, Louis Theodore, HANDBOOK OF CHEMICAL AND ENVIRONMENTAL ENGINEERING CALCULATIONS, John Wiley & Sons, Inc., New York, 2002.
Nicholas P. Cheremisinoff, Handbook of Air Pollution Prevention and Control, Elsevier Science, 2002.
Greenhouse gas emission trends and projections in Europe, EEA, 2002.
Prospects for CO2 Capture and Storage, IEA, 2004.

Environmental engineering science

ID: PhD-3098
teaching professor: Jovović M. Aleksandar
ECTS credits: 5

goals

The aim of this course is introducing candidates with problems and problem solving in the field of environmental protection by appropriate scientific methods; subject is designed as an introductory course in the field of environmental engineering at the level of doctoral studies; subject focuses on key points such as efficient and harmless systems for the environment, exploitation and conversion of energy sources, transportation and distribution, and use of final energy demand by end users in all sectors of production and consumption.

learning outcomes

At the end of the course it is expected that the candidate has mastered the basic knowledge related to the analysis and evaluation of scientific papers, the basis of laboratory work, and on the basis of the process of dispersion modeling of pollutants in the environment.

theoretical teaching

Introduction. Multidisciplinary of environmental protection. Process engineering and environmental protection. The effects of air, soil and water pollution, emissions, immissions. General legal basis for environmental protection and the basics of making norms. Possible sources of risk, risk and pollution levels, measuring the concentration of pollutants. Apropriate measures for living and working environmental protection. Technical standards, modalities of solving or planning. The design and operation of facilities, possibilities and use of low-polluting analogy from the standpoint of rational use of energy of materials and natural resources, equipment for air, fuel and water cleaning, classification and characteristics of the protection methods, application and properties of materials for construction of environmental protection equipment. Sources and types of solid, liquid and gaseous wastes, processes and waste treatment plants.

practical teaching

Laboratory work if needed; writing scientific papers etc.

prerequisite

There is no previous requirements for attending this course.

learning resources

Laboratory installation and measuring equipment if needed; numerous literature and access to numerous international databases.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 10; calculation tasks:

0; seminar works: 85; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Nazaroff, W., Environmental Engineering Science, John Wiley and Sons, 2001., ISBN 0-471-14494-0
Kuburović, M., Jovović A., et al., Zaštita životne sredine, str. 644-856., Termotehničar, vol. 2, Interklima, Vrnjačka Banja, SMEITS, 2004, ISBN 86-82685-03-5
Kiely, G., Environmental engineering, McGraw-Hill, 1998., ISBN 0-07-709127-2
Allen, D.T., Sinclair Rosselot, K., Pollution prevention for chemical processes, John Wiley and Sons, 1997., ISBN 0-471-11587-8

Epistemology of Science and Technique

ID: PhD-3076
teaching professor: Zeković N. Dragomir
ECTS credits: 5

goals

Introduce students to the history of science and technique.

learning outcomes

After examining the history of science and technology, students will be able to assess the future development and trends in science and technique.

theoretical teaching

"Human and Culture: a symbol, a prehistory of techniques, Sumer, Egypt and Babylon.
Epistemology and the beginnings of science and technology: a rational understanding of knowledge, Aristotle's concepts (technical and techniques).
Science and Technology in the Middle Ages: an empirical approach, a rational approach, modus tollens, modus ponens.
Science and technology in humanism and the Renaissance: from Cusanus . Hypotheses and astronomy: Copernicus, Brahe, Kepler. Movement and Cartesianism: Beckman, Descartes, Galileo and experimentum crucis.
Rational mechanics: Huygens, Newton, epistemics holistic, analytical mechanics. The hidden structure of metals. Evolution and the Industrial Revolution: a heat machine and arrow of time. The world of atoms and quantum mechanics: quantum time and technique. Artificial intelligence: semantic information processing, microscopic cybernetics. Synergy and ecology.

practical teaching

prerequisite

learning resources

Crombie A.; Robert Grosseteste and the Origin of Experimental Science, 1100-1700, London, 1952.
Dijksterhuis E.; The Mehanization of the World Picture, Princeton, 1986.
Rousseau P.; Historie des Techniques, Paris, 1956.
Dijem, P., Cilj i struktura fizičkih teorija, Novi Sad, 2003.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

Crombie A.; Robert Grosseteste and the Origin of Experimental Science, 1100-1700, London, 1952.
Dijksterhuis E.; The Mehanization of the World Picture, Princeton, 1986.
Rousseau P.; Historie des Techniques, Paris, 1956.
Dijem, P., Cilj i struktura fizičkih teorija, Novi Sad, 2003.

Especial Chapters of Theory of Machines and Mechanisms

ID: PhD-3204
teaching professor: Petrović V. Dragan
ECTS credits: 5

goals

To familiarize students with the latest developments in the theory of machines and mechanisms related to the analysis and synthesis of mechanisms, mechanisms of variable structure, spatial mechanisms, cam mechanisms, gear and cloc mechanisms.

learning outcomes

Students acquire the necessary knowledge and skills required to design and construct mechanisms and machines. Also, students are trained in the use of appropriate programs for analysis of kinetic mechanisms of different size structures.

theoretical teaching

The formation of the theory of machines and mechanisms. Mechanisms and their classification. Structural analysis of the mechanism. Kinematic analysis of mechanisms. Analysis of the force. The process of constructing a machine.

practical teaching

Accomplishing the project work whose theme is closely related to doctoral student works.

prerequisite

learning resources

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Essential Techniques in Programming Languages

ID: PhD-3349
teaching professor: Radojević LJ. Slobodan
ECTS credits: 5

goals

The aim is to familiarize Ph.D. students with some relevant data structures and algorithms that are typical in mechanical engineering.

learning outcomes

PhD student would recognize the necessity to use a list in data processing. Also, he would recognize the basic algorithms for processing lists.

theoretical teaching

1. Record as data structures.
2. Pointer as the primary means of creating a list.
3. Simple linked list.
4. Add new record in the list. Add new record to the beginning, middle and end of the list.
5. Deleting a record from the list. Delete records from the beginning, middle and end of the list.
6. Simple algorithms for searching the list.
7. Tree data structures.
8. Simple algorithms for searching a tree.

practical teaching

Use the list as a basis for the analysis of acquisition data contained in the file. As the data acquisition process is handled online or in partial temporal moments, the idea is to enter the list. The processing of the entries in the data acquisition and adjusted for easier analysis. PhD students will be familiar with some of the algorithms for sorting and searching arrays, strings and lists.

prerequisite

C and basic Programming.

learning resources

The necessary software for this course under the GNU license - free of charge.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 0; calculation tasks: 0; seminar works: 45; project design: 0; final exam: 50; requirements to take the exam (number of points): 0

references

Experimental data acquisition and processing

ID: PhD-3039
teaching professor: Glavonjić M. Miloš
ECTS credits: 5

goals

1) To receive basic knowledge about sensors, signals conditioning and experimental data acquisition.
2) To receive basic knowledge about methods for design of experiments (DOE).
3) To receive practical knowledge about experimental data processing.
4) To receive training in testing procedures for machine tools and machining systems.
5) To know how to make technical projects and testing report.

learning outcomes

1) Basic know how about sensors, signals conditioning, and experimental data acquisition.
2) Ability to design and perform the experiment to test a machine tool, and to identify the machining process.
3) Skill to cope with the experimental data processing.
4) Skill to choose the method, prepare the machine for testing, and finish the testing procedure.
5) Basic know how about making technical projects and testing reports.

theoretical teaching

New teaching contents:
1) Sensors for testing of machine tools and machining systems. Dynamometers. Accelerometers.
2) Design of experiment (DOE).
3) Signal conditioning and experimental data acquisition.
4) Experimental data processing.
5) Methods for identification of continuous-time models from sampled data.

Elaboration of new teaching contents and instructions for doing the tasks:
1) Sensors preparing and calibrations.
2) Preparing for the designed experiments.
3) Experimental setup for data acquisition.
4) Methods and software for experimental data processing.
5) Examples for identification of continuous-time models from sampled data.

practical teaching

Practical teaching involves laboratory work in Laboratory for machine tools and machining systems, and seminar work writing. Planned experiments are carried out in the Laboratory with finishing the reports. These reports are a part of the seminar work.

prerequisite

Study curriculum and student motivation for learning experimental data acquisition and processing according to the goals set and outcomes offered.

learning resources

Laboratory for machine tools and machining systems, which includes both hardware and

software:
1) Different kinds of sensors (accelerometers, dynamometers etc.).
2) The systems for experimental data conditioning and acquisition.
3) Software for experimental data processing.
4) The systems for laboratory testing of machine tools accuracy.
5) The system for circular interpolation test.
6) Test bed for identifying parameters of mechanistic cutting forces models.
7) Test bed for cutting process optimization, feed scheduling, and integrated simulation of machine tool and process.
8) Software for virtual machining system simulations.
9) Test bed for parallel kinematics machine tools.
10) Test bed for configuring and programming of modular open architecture machine tools (MOMA).
11) Test bed for the STEP-NC protocol based programming of CNC machines.
12) Hardware needed for basic modal analysis (modal hammer, accelerometers etc.).
13) Software for basic modal analysis.
14) Functional simulator of the rapid prototyping machine tool.
15) Software for basic optimization of machine tools structures.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

S. M. Pandit, S-H. Wu, Time series and system analysis, with applications, John Wiley & Sons, 1983, ISBN 0-471-86886-8.
H. G. Natke, Einfuerung in Theorie und Praxis der Zeitreihen- und Modalanalyse, Vieweg, 1983, ISBN 3-528-08145-7.
H. L. Wang, Eds, Identification of Continuous-time Models from Sampled Data, Springer, 2008, ISBN 978-1-84800-160-2.
J. Park, S. Mackay, Practical Data Acquisition for Instrumentation and Control Systems, Elsevier, 2003, ISBN 07506 57960.
T. L. Schmitz, K.S. Smith, Machining Dynamics, Frequency Response to Improved Productivity, Springer, 2009, ISBN 978-0-387-09644-5.

Explosive applications

ID: PhD-3090
teaching professor: Jaramaz S. Slobodan
ECTS credits: 5

goals

Acquiring knowledge from the field of explosive application and testing.

learning outcomes

Student has knowledge in the field of application and testing of explosives for various military purposes.

theoretical teaching

Introduction to explosives.
Fundamentals of physics of explosive processes.
Theories and methods of initiation of explosives.
Explosive propulsion.
Testing of explosives.

practical teaching

Fundamentals of physics of explosive processes - calculation examples.
Theories and methods of initiation of explosives - selected examples.
Explosive propulsion - Gurney method.
Testing of explosives - analysis of different testing methods.

prerequisite

learning resources

1. Jaramaz, S.: Physics of explosion, Faculty of Mechanical Engineering, Belgrade, 1997.
2.Zukas, J.A., Walters, W.: Explosive effects and applications, Springer, 1998.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Suceska, M.: Test methods for explosives, Springer, 1995.
Meyer, R., Kohler, J., Homburg, A.: Explosives, Wiley, 2002.

Failure Diagnostic

ID: PhD-3032
teaching professor: Vencl A. Aleksandar
ECTS credits: 5

goals

The student attending this course should:
• Comprehend the significance of failures from the technical and economic aspects;
• 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

On the basis of mastered knowledge the student is qualified to define the necessary parameters and procedures that allow failure monitoring and contribute to the process of maintaining the modern machines and equipment, especially tribological systems and mechanisms.

theoretical teaching

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. The role of diagnostics and failure analysis in the maintenance of mechanical systems. Types of maintenance. Proactive maintenance. Benchmarking and road-map to excellence. Failures and analysis of maintenance costs. Management and technical strategy. Fault tree, FMEA analysis, Pareto analysis, etc. Types of failures in machine elements and systems. Failures case studies. Algorithms for the selection of monitoring methods. Analysis of results and corrective measures.

practical teaching

prerequisite

learning resources

1. A. Rac, Fundamentals of Tribology, Faculty of Mechanical Engineering, Belgrade, 1991, (in Serbian).
2. A. Rac, Lubricants and Machine Lubrications, Faculty of Mechanical Engineering, Belgrade, 2007, (in Serbian).
3. A. Rac, A. Vencl, Sliding Bearing Metallic Materials – Mechanical and Tribological Properties, Faculty of Mechanical Engineering, Belgrade, 2004, (in Serbian).
4. M. Babić, Monitoring of Lubricating Oils, Faculty of Mechanical Engineering, Kragujevac, 2004, (in Serbian).
5. Technical Diagnostic – Journal, (in Serbian).

number of hours

lectures: 35
research: 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: 70; project design: 0; final exam: 30; requirements to take the exam (number of points): 35

references

E.D. Yardley, Condition Monitoring: Engineering the Practice, John Wiley and Sons, New York, 2002.
B. Jeremić, Terotechnology: Maintenance Technology of Technical Systems, Eskod, Kragujevac, 1992, (in Serbian).
R.A. Callacott, Mechanical Fault Diagnosis and Condition Monitoring, Chapman and Hall, London, 1977.
H. Braun (Ed.), Handbook of Loss Prevention, Springer, Berlin, 1978.

Fatigue and structural life of aeronautical constructions

ID: PhD-3278
teaching professor: Stupar N. Slobodan
ECTS credits: 5

goals

The goal of this course is to introduce students to the field of fatigue of aircraft structures. Including basic theoretical knowledge of fatigue and fracture mechanics, students are trained for proper use of modern software tools. After attending the cours, finishing all exercises and giving the final presentation, students should be able to identify the cause of fatigue cracks, type of load that brought to the development of fatigue cracks and to analyze aircraft structural life to the occurrence of fatigue cracks and to determinate residual aircraft structural life. Also, after passing the course students should be independent in estimation where fatigue crack will occur in the structure, based on a known load spectrum, by using modern software tools.

learning outcomes

By successfully adopting the program of the course, a student acquires theoretical and practical knowledge to recognize type of fatigue, to determine the critical point for the fatigue crack appearance, to recognize the nature of the dynamic loads, task boundary condition for the simulation of crack growth, independent assess which numerical method gives the best problem approximation, and to determine the fatigue life of the structure before and after the fatigue crack.

theoretical teaching

Introduction to fatigue life assessment of aircraft structures.
Basic concepts in the study of fatigue characteristics.
Introducing the concept of damage tolerance, safe and reliable structure.
Introduction to elastic fracture mechanics in the assessment of fatigue crack growth and residual strength of aircraft structures.
Presentation in describing the static fracture and residual strength of the structure.
Analytical and numerical determination of crack growth.

practical teaching

Practical training accompanies materials presented during theoretical lectures. In the beginning, students familiarize with work by using modern software tools, followed by presents the examples that illustrate the theoretical lessons. Examples are the complete whole of the problem, setting the boundary conditions, correction in solving complex problems, graphical representation оф solution and its analysis. Students solve their homework independently and present it to their colleagues.

prerequisite

There is no necessary requirement for attendance of Fatigue and structural life of aeronautical constructions.

learning resources

Simlab - computer laboratory

number of hours

lectures: 35
research: 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

Јовичић Г., Живковић М., Вуловић С., Прорачунска механика лома и замора, Машински факултет Универзитета у Крагујевцу, Крагујевац 2011.
Manson S., Halford G., Fatigue And Durability of Structural Materials, ASM International, 2006.
Selected research articles and conference papers
Additional materials (written performed with the lectures, setting tasks, guidelines for solving the task)

Fatigue of Thin Walled Structures

ID: PhD-3380
teaching professor: Grbović M. Aleksandar
ECTS credits: 5

goals

The goal of this course is to provide students with a theoretical and practical knowledge of the modern techniques for fatigue data acquisition, data analysis, test planning and practice. More specifically, it covers the most comprehensive methods to capture the thin walled structure load, to characterize the scatter of fatigue resistance and loading and to perform the fatigue damage assessment of a structure.
Basic concepts of fatigue and fracture are also covered.

learning outcomes

Knowledge of the mechanism of crack initiation in the material and how crack propagation can be predicted using different methods are the most important outcomes of this course. The students will also gain knowledge about so-called "design against fatigue" and will be able to predict (with good accuracy) the fatigue performance of thin walled structures, fatigue limits, fatigue lives until crack initiation and the remaining life covered by crack growth until final failure.

theoretical teaching

1. Basic Concepts of Fatigue and Fracture of Thin Walled Structures
2. Fatigue-Life Prediction: Total-Life and Safe-Life Approach; Damage-Tolerant Approach; Methods of Fatigue-Life Prediction at a Glance.
3. The K Concept of LEFM; Crack-Tip Plasticity: Concepts of Plastic-Zone Size and The J Integral.
4. Crack Initiation: Definition and Significance; Influence of Notches, Surface Treatment and Residual Stresses; Influence of Microstructual Factors on the Initiation of Fatigue Cracks.
5. FE and Analytical Calculations of Elastic Anisotropy Stresses to Predict Crack Initiation Sites; ANSYS software.
6. Modeling Crack Propagation: Numerical Modeling of Short-Crack Propagation by Means of a Boundary Element Approach; NASGRO and AFGROW softwares.
7. Modeling Crack Propagation: General Strategies of Fatigue Life Assessment; Numerical Modeling of Crack Propagation by Means of a Extended Finite Element Method (XFEM) Approach; ABAQUS and Salome MECA softwares.
8. Experimental Approaches to Crack Propagation: Crack-Propagation Measurements; Potential-Drop Concepts and Fracture Mechanics Experiments.

practical teaching

1. Cycle Counting Techniques Through Examples - LEVEL CROSSING CYCLE COUNTING, PEAK-VALLEY CYCLE COUNTING, RANGE COUNTING, RAINFLOW METHOD.
2. Stress-Based Fatigue Analysis and Design Through Examples
3. Fracture Mechanics and Fatigue Crack Propagation: Examples (ANSYS, Abaqus, FRANC2D&3D)

prerequisite

Fundamental background in FEM is recommended.

learning resources

Handouts, Virtual classroom (Moodle), Powerpoint presentations, Computers with ANSYS and Abaqus software, Recommended literature and websites

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

A. Grbovic, Handouts, Faculty of Mechanical Engineering, Belgrade, 2012.
Hathaway R. et.al., Fatigue Testing and Analysis (Theory and Practice), Elsevier Inc., 2005.
Schijve J, Fatigue of Structures and Materials, Springer, 2009.

Finite element method

ID: PhD-3147
teaching professor: Maneski Đ. Taško
ECTS credits: 5

goals

Mastering of the Finite Element Method and an active work on the computer. Modeling and calculation of complex structures and problems. Determination of displacements and stresses. Finding the real structure behavior in its operation. Reliable prediction of structural response and determination the cause of bad behavior, yielding and damage of structure. Static, thermal and dynamic analysis.

learning outcomes

The course provides skills to acquisition modeling and design of structures using computers and Finite Element Method. This allows solving the real problems of structural strength in its service life. Mastering the course will enable the application on different areas and active work on the computer using finite element method.

theoretical teaching

Introduction. Finite element modeling of the geometry of the supporting structures. The theory of elasticity. Finite element method. Line primitives and finite elements. Surface primitives and finite elements. Volume primitives and finite elements. Defining characteristics of the elements. Static and thermal analysis. Dynamic analysis. Analysis of the calculation of structure. Computer modeling and calculation of real problems. Load distribution in the structure. Diagnosis of the strength of structure behaviour. Elements of structure optimization.

practical teaching

Working with Programe package KOMIPS. The tasks from line primitives. The tasks of surface primitives. The tasks of volume primitives. Principles of computer modeling and generation of structure geometry. Adding primitives to generate finite element meshes. Computer modeling of supports and loads. Exercise of collecting primitives and generating network elements. Exercise of defining the characteristics of elements, supports and loads. Examples of static and thermal calculation. Examples of dynamic calculation. Diagnostics of structural behavior. Seminar papers from modeling, calculations, load distribution on the structure, analysis of structure calculation, defining elements of structure optimization.

prerequisite

No condition

learning resources

1. T. Maneski, Computer modeling and calculation of structures, Faculty of Mechanical Engineering, 1988 - KPN
2. T. Maneski, V.Milošević-Mitic, D. Oštrić, The statement of structural strength, Faculty of Mechanical Engineering, Belgrade, 2000 - KPN
3. T. Maneski, Resolved problems of structural strength, faculty of Mechanical Engineering, Belgrade, 2000 - KPN
4. KOMIPS - a software package for the calculation of structures - ICT - IAS

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Finite Element Modelling

ID: PhD-3359
teaching professor: Maneski Đ. Taško
ECTS credits: 5

goals

Mastering of the Finite Element Method and an active work on the computer. Modeling and calculation of complex structures and problems. Determination of displacements and stresses. Finding the real structure behavior in its operation. Reliable prediction of structural response and determination the cause of bad behavior, yielding and damage of structure. Static, thermal and dynamic analysis.

learning outcomes

The course provides skills to acquisition modeling and design of structures using computers and Finite Element Method. This allows solving the real problems of structural strength in its service life. Mastering the course will enable the application on different areas and active work on the computer using finite element method.

theoretical teaching

Introduction. Finite element modeling of the geometry of the supporting structures. The theory of elasticity. Finite element method. Line primitives and finite elements. Surface primitives and finite elements. Volume primitives and finite elements. Defining characteristics of the elements. Static and thermal analysis. Dynamic analysis. Analysis of the calculation of structure. Computer modeling and calculation of real problems. Load distribution in the structure. Diagnosis of the strength of structure behaviour. Elements of structure optimization.

practical teaching

Working with Programe package KOMIPS. The tasks from line primitives. The tasks of surface primitives. The tasks of volume primitives. Principles of computer modeling and generation of structure geometry. Adding primitives to generate finite element meshes. Computer modeling of supports and loads. Exercise of collecting primitives and generating network elements. Exercise of defining the characteristics of elements, supports and loads. Examples of static and thermal calculation. Examples of dynamic calculation. Diagnostics of structural behavior. Seminar papers from modeling, calculations, load distribution on the structure, analysis of structure calculation, defining elements of structure optimization.

prerequisite

No condition

learning resources

1. T. Maneski, Computer modeling and calculation of structures, Faculty of Mechanical Engineering, 1988 - KPN
2. T. Maneski, V.Milošević-Mitic, D. Oštrić, The statement of structural strength, Faculty of Mechanical Engineering, Belgrade, 2000 - KPN
3. T. Maneski, Resolved problems of structural strength, faculty of Mechanical Engineering, Belgrade, 2000 - KPN
4. KOMIPS - a software package for the calculation of structures - ICT - IAS

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Finite Elements Methods in Applications

ID: PhD-3342
teaching professor: Grbović M. Aleksandar
ECTS credits: 5

goals

The goal of this course is to provide students with a practical knowledge of the finite element method and the skills required to analyze engineering problems with ANSYS, a commercially available FEA program.
In addition to the fundamental topics, course presents advanced topics concerning modeling and analysis. These topics are introduced through extensive examples in a step-by-step fashion from various engineering disciplines.

learning outcomes

This course will give students a sense of how the finite element method can be used, not only to calculate the response of complex structures that have already been defined, but also to develop a good understanding of structural behaviour that can be used in design.
By completing the course, students will acquire a foundation of knowledge of completed works of structural engineering and will be able to solve advanced problems using software for finite element analysis (ANSYS).

theoretical teaching

1. INTRODUCTION
Concepts, Nodes, Elements, Direct Approach.
2. FUNDAMENTALS OF ANSYS
Organization of ANSYS Software, ANSYS Analysis Approach, ANSYS Preprocessor, ANSYS Solution Processor, ANSYS General Postprocessor, ANSYS Time History Postprocessor, ANSYS File Structure (Database File, Log File, ErrorFile, Results Files), Description of ANSYS Menus and Windows, Using the ANSYS Help System.
3. FUNDAMENTALS OF DISCRETIZATION
Local and Global Numbering, Approximation Functions, Coordinate Systems, Shape Functions
4. ANSYS PREPROCESSOR
Fundamentals of Modeling, Modeling Operations, Elements, Real Constants, Material Properties, Element Attributes, Solid Modeling, Boolean Operators, Meshing.
5. ANSYS SOLUTION AND POSTPROCESSING
Solution, Analysis Options/Solution Controls, Boundary Conditions, Initial Conditions, Body Loads, Solution in Single and Multiple Load Steps, Failure to Obtain Solution, Postprocessing, General Postprocessor, Time History Postprocessor, Read Results, Plot Results, Element Tables, List Results.
6. LINEAR STRUCTURAL ANALYSIS
Static Analysis, Linear Buckling Analysis, Thermomechanical Analysis, Fracture Mechanics Analysis, Dynamic Analysis.
7. NONLINEAR STRUCTURAL ANALYSIS
Geometric Nonlinearity, Material Nonlinearity, Combined Plasticity and Creep, Contact.
8. ADVANCED TOPICS IN ANSYS
Coupled Degrees of Freedom, Writing Data to External ASCII Files, Executing an External File, Modifying the ANSYS GUI

practical teaching

THE FINITE ELEMENT METHOD AND APPLICATIONS IN ENGINEERING (USING ANSYS):

Practical examples - Trusses, Beams, Three-dimensional Problems, Two-dimensional Idealizations, Plates and Shells, Modal Analysis, Harmonic Analysis, Transient Analysis, Large Deformation Analysis of a Plate, Post-buckling Analysis of a Plate with a Hole, Plastic Deformation of an Aluminum Sphere, Plastic Deformation of an Aluminum Cylinder, Fracture Analysis of a Plate With Hole.

prerequisite

Fundamental background in finite element method is required.

learning resources

Handouts, Virtual classroom (Moodle), Powerpoint presentations, Computers with ANSYS software, Recommended literature and websites

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

A. Grbovic, Handouts, Faculty of Mechanical Engineering, Belgrade, 2009.
Moaveni S Finite Element Analysis: Theory and Application with ANSYS, 3rd Edition, 2009.

Fire control and comand- information systems

ID: PhD-3157
teaching professor: Milinović P. Momčilo
ECTS credits: 5

goals

To introduce applicants with modern control systems of fire power activities, and control functions of weapon during proceedings of combat exploitations based on theoretical approach of mechanics and mathematics in the variable and virtual initial and eugenvalues conditions of launching and projectiles flight of different integrated weapon and combat platforms types .To observed technology integration of weaponized unit effect ,combat platform, and weapon during combat deployment,with modern defence information technologies of Control and Command in the 3D space.To determined the properties of digitalized and full integrated battle field during time in aim to tracking and control of combat organizational weaponized systems on the C4I levels

learning outcomes

Applicant achieved knowledge for individual design of weapon systems functions with appropriate equipment integrated in to the weapon subsystem.Knowledge achieved are about types and character of equipment and sensors for shooting functions control and space navigation of weaponized systems.Proceedings are accorded with requirements of Mechanics and Mathematics , respecting accuracy and precision of Weapon and equipment.

theoretical teaching

Theoretical lessons circled ,
- probabilities of shooting accuracy and precisions of weapon
-Mechanics and following proceedings of shooting with different projectiles
-Digitalization of targets tracking and shooting performances measurements
-The types of mil.sensors
-Navigation of air ,land ,and water platforms based on inertial and GPS satellite systems
-Time proceedings and ordering of command systems and units.

practical teaching

-Simulation software on the computer

prerequisite

Consultative of seminar papers

learning resources

Computers and software systems

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

M.Milinovic , Modeling of FC and tracking Systems of areal targets , (serb) ,EDIT.OF ,MEF ,BGD, 2002
C.Gacovic ,Tracking of low altitudes areal targets Peack impoulse LOS radars,VIZ.BGD, 1999
M.Kolawole ,Radar systems peck detection and tracking ,Newnes,Oxford,2002
A.Chatfield , Fundamentals of high acuraccy inertial navigation,AIAA ,Vol 174, 1997, Paul Zarchran ed.

Flight Dynamics

ID: PhD-3234
teaching professor: Rašuo P. Boško
ECTS credits: 5

goals

Introducing students to the dynamics of atmospheric flight, orbital and interplanetary flight. Also, during this course in subjects like complex phenomena and dynamic stability and control of modern aircraft.

learning outcomes

Students will be introduced to the procedure of abstract thinking and creative idea generation, the methodology of the design and development of new aircraft and spacecraft on the most advanced technological solutions.

theoretical teaching

Equations of aircraft motion in the atmospheric, orbital and interplanetary flight. Modelling of aircraft flight dynamics. Dynamic stability, maneuverability, agility and meneuverability of aircraft. Differential equations of aircraft stability. The criteria of stability of dynamical systems. Aerodynamic stability derivatives of aircraft. Systems of equations of generalized stability and control of aircraft and missile systems. Inverse Problems of Stability. Flight in a turbulent atmosphere.

practical teaching

Modeling and Simulation of Flight path with MATLAB and Simulink. Simulation parameters of flight in wind tunnels.

prerequisite

No special conditions

learning resources

Robert F. Stengel, Flight Dynamics, Princeton Univ. Pr., 2004., Michael V. Cook, Flight Dynamic Principles: A Linear Systems Approach to Aircraft Stability and Control, Butterworth-Heinemann, Oxford, 2007 and Ashish Tewari, Atmospheric and Space Flight Dynamics: Modeling and Simulation with MATLAB and Simulink, Birkhauser, 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

lectures: 35
research: 0

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): 40

references

Robert F. Stengel, Flight Dynamics, Princeton Univ. Pr., 2004.
Michael V. Cook, Flight Dynamic Principles: A Linear Systems Approach to Aircraft Stability and Control, Butterworth-Heinemann, Oxford, 2007
Ashish Tewari, Atmospheric and Space Flight Dynamics: Modeling and Simulation with MATLAB and Simulink, Birkhauser, 2006

Flight Mechanics

ID: PhD-3235
teaching professor: Rašuo P. Boško
ECTS credits: 5

goals

Introduce students to the complex problems of modern developments of high-speed aircraft in the atmospheric and orbital flight. Subjects like performance and extreme maneuvers of aircraft.

learning outcomes

Mastering new skills students acquire sufficient theoretical knowledge to be able to be creatively self-define the extreme-performance capabilities of modern high-speed aircraft and any restrictions on flight opportunities that arise from it.

theoretical teaching

Problems of atmospheric flight mechanics and orbital flight with supersonic and hypersonic speeds. The performance of supersonic aircraft. Energy calculation methods performance aircraft. The optimal method of climbing program of total energy, the steepest climb, minimum fuel consumption, outside the boundary conditions are extremal. Impact of external loads on aircraft performance. Super-performance fighter aircraft maneuvering. Agility of combat aircraft. Flight envelope and Polar-loading of aircraft. Stolling flight and spin of aircraft. Analysis of flight of an airplane in spin. Spin recovery. Flight mechanics unmanned aircraft and their flight envelope.

practical teaching

Modeling and Simulation of Flight path with MATLAB and Simulink. Simulation parameters of flight in wind tunnels.

prerequisite

No special conditions

learning resources

Nguyen X. Vinh, Flight Mechanics of High Performance Aircraft, Cambridge University Press, 1999, Warren F. Phillips, Mechanics of Flight, John Wiley & Sons, 2004, Ashish Tewari, Atmospheric and Space Flight Dynamics: Modeling and Simulation with MATLAB and Simulink, Birkhauser, 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

lectures: 35
research: 0

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): 40

references

Nguyen X. Vinh, Flight Mechanics of High Performance Aircraft, Cambridge University Press, 1999.
Warren F. Phillips, Mechanics of Flight, John Wiley & Sons, 2004.
Ashish Tewari, Atmospheric and Space Flight Dynamics: Modeling and Simulation with MATLAB and Simulink, Birkhauser, 2006.

Fluid measurements

ID: PhD-3191
teaching professor: Nedeljković S. Miloš
ECTS credits: 5

goals

The main aim of this lectures is to refer the doctoral students involved in the specific fields of fluid measurements course, so as the energetics and cavitation measurements of the hydraulic machines and equipment.

learning outcomes

The knowledge of the fluid flow values measurements for the quality investigation is necessary. Also the important fluid measurements methods are introduced in this lectures.

theoretical teaching

1. Parameters measurement of the incompressible and compressible flow.
2. Specifics of the measuring devices.
3. Velocity measuring using the hot-wire anemometers. Calibration procedures.
4. Hot-wire temperature-compensation.
5. Turbulent characteristics measurements.
6. Thermodynamic method for the pump and turbine hydraulic efficiency determination.
7. Non-invasive measuring methods for the qualitative and quantitative velocity flow field determination: Laser-Doppler anemometry (LDA) and Particle Image Velocimetry (PIV).
8. Thermodynamic method for the pump and turbine hydraulic efficiency determination using fluid muffler.
9. Flow measurement methods.
10. Measurement energetic and cavitation characteristics of the valves devices.
11. Determination cavitation characteristics of hydraulic machines and valves.
12. Laboratory testing of air handling units.

practical teaching

Laboratory measurements: Probe calibration for velocity and pressure measuring.

prerequisite

-

learning resources

Printed lectures - hand out.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Holman, J, "Experimental methods for engineers", Internatiional student edition, Mc Graw – Hill Company, 1984,
Goldstein, R., "Fluid Mechanies Measurements", Springer – Verlag, Berlin, 1983,
Raffel M., Willert C., Wereley S., Kompenhans J., "Particle Image Velocimetry - Practical Guide", Springer - Verlag, Berlin, Heidelberg, 2007.
Vukolsavčević P., Petrović D., "Multiple Hot-wire Probes - Measurements of Turbulent Velocity and Vorticity Vector Fields", Montenegrin Academy of Sciences and Arts, Podgorica, 2000.

Forensic Engineering - Special Chapters

ID: PhD-3065
teaching professor: Duboka V. Čedomir
ECTS credits: 5

goals

Student will be educated, trained and qualified to apply forensic engineering methods and to apply it in research activities within the subject area, which in particular is Motor vehicles. It comprises analyses and reconstruction of road accidents, vehicle damage estimation and vehicle value estimation based on case study principles. Analogous methods will be applied in other filed of mechanical engineering, depending on the interest of students.

learning outcomes

General:
- analyze, synthesize, solution prediction, consequence estimation
- acquiring research methods, procedures and processes
- development of critical and self-critical approach and approach
- application of knowledge in practice
- professional ethics.

Subject - specific:
- acquiring knowledge in teaching area (T/A)
- knowing and understanding of T/A and profession
- resolution to T/A practical problems
- synergy of knowledge fro different T/A
- follow-up and application of professional novelties
- T/A knowledge application
- application of ICT in T/A

theoretical teaching

Organized in blocks depending on the candidate's closer interest:
First Block : general knowledge on forensics and forensic engineering, i.e. technical systems failure analyses, their causes and consequences, with a particular emphasis on the area of automotive engineering.
Second Block : Vehicle condition changes and value estimation methods
Third Block : Vehicle and component failures, i.e. accidents causing vehicle damage
Fourth Block : Vehicle damage estimation techniques and repair costs
Fifth Block : Analyses of road vehicle accident causes and consequences, with the elements of accident cite investigation and evidence collection, including accident reconstruction.

practical teaching

Organized in the form of case study elaboration based on application of appropriate forensic engineering methods.

prerequisite

none

learning resources

1. Class room

2. Other author book
3. Foreign language books
4. Other literature
5. IT Hardware
6. IT software

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Handouts
Randall K. Noon, Forensic Engineering Investigation, CRC Press, 2001, ISBN 0-8493-0911-5
Wolfgang Hugemann, Unfall-rekonstruktion, Authoren Team GbR, 2007, ISBN 3-00-019419-3
R.M. Brach, R.M. Brach, Vehicle Accident Analysis and Reconstruction Methods, SAE Intl. ISBN 0-7680-0776-3, 2005
Internet

Fractional calculus with applications in engineering

ID: PhD-3128
teaching professor: Lazarević P. Mihailo
ECTS credits: 5

goals

Introduce students to basic concepts of fractional calculus. It is possible to solve problem of modeling as well as control task of the fractional order system (FOS) using modern theory based on fractional calculus. Determination (simulation) models of FOS - i.e. fractional differential equations of motion of the FOS, as well as fractional order controls which are important in practical problems of the FOS.Practical simulations FOS using MATLAB software package.

learning outcomes

By attending this course student acquires the ability to analyze problems and synthesis solutions to the problem of modeling and control of given fractional order systems using scientific methods of fractional calculus. This enabled him applying solutions to practical problems of fractional order systems as well as monitoring and implementation of innovation of new results of fractional calculus.

theoretical teaching

Basic definitions and properties of fractional derivatives and integrals.
Cauchy type problem for ordinary fractional linear equations. Fractional existence and uniqueness theorems. Equations with the Riemann-Liouville fractional derivative. Equations with the Caputo derivatives in the space of continuous differentiable functions. Laplace transform method for solving ordinary differential equations with R-Liouville fractional derivatives.Laplace transform method for solving ordinary differential equations with Caputo fractional derivatives.Solution of Cauchy type problems for given fractional equations. Fractional order control.Numerical methods for fractional order systems.Applications with MATLAB for given fractional order system-examples in engineering.

practical teaching

Applications MATLAB for given fractional order systemc
-examples in engineering.

prerequisite

none

learning resources

1.M.Lazarević, Lj.Bučanović, Contribution to modelling and dinamical analysis of fractional order system with fundamentals of fractional calculus
2.Podlubny I. Fractional Differential Equations. Academic Press, San Diego,1999
3.Kilbas, Srivastava, H.M., Trujillo, J.J.Theory and Applications of Fractional Differential Equations. Elsevier, Amsterdam,2006.
4.Hilfer R, Ed., Applications of Fractional Calculus in Physics,World Scientific, River Edge, NJ, USA, 2000.
5.AV Pskhu, AP Soldatov, Partial differential equations of fractional order, Nauka, Moscow, 2005

6.Written abstracts from the lectures (Handouts)
7.MATLAB,MATHEMATICA-mathematics software packages

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

Oldham K B and J. Spanier, The Fractional Calculus: Theory and Applications of Differentiation and Integration to Arbitrary Order, Academic Press, New York, NY, USA, 1974
C. A. Monje, YQ. Chen, B. M. Vinagre, D. Xue, V. Feliu, Fractiona Order Systems and Controls – Fundamentals and Applications, Springer, 2010
K. S. Miller, B. Ross, An Introduction to the Fractional Calculus and Fractional Differential Equations, John Willey & Sons, Inc. 1993
R. Magin. Fractional Calculus in Bioengineering. Begell House, Inc. 2006
J.Sabatier,O Agrawal,J.Machado,ADVANCES IN FRACTIONAL CALCULUS,Springer,Netherlands,2007.

Fuels and selected topics in combustion

ID: PhD-3272
teaching professor: Stojiljković D. Dragoslava
ECTS credits: 5

goals

Introduction to modern approaches of characterization, production, processing and application of fuel.

learning outcomes

Acquiring knowledge about modern methods of characterization, production, processing and application of fuels (solid, liquid and gas).

theoretical teaching

Energy sources. Energy reserves, production and consumption of fuels (solid, liquid and gaseous; natural and manufactured). Modern methods of fuel characterization - the application of modern methods of testing. Evaluation of fuel based on energy, environmental and economic criteria. Methods of fuel processing - modern techniques and development trends. Possibilities for application of fuels in various modern combustion processes.

practical teaching

Depending on defined topics of doctoral thesis the appropriate program of experimental work on the thesis is adopted.

prerequisite

none

learning resources

Laboratory facility / installation / machine (LPI):
1. Laboratory facility for investigation of the solid fuels
combustion
Laboratory equipment for testing the fuels:
1. Various instruments for testing physical and chemical characteristics of solid and liquid fuels.
and other facilities and installations as needed

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Standard Handbook of Petroleum & Natural Gas Engineering, Vol. 1, 2, 3, Butterworth-Heinemann, 1996.
Carpenter A., Skorupska N., Coal combustion - Analysis and Testing, IEA, 1993.
Rutz D., Janssen R., Biofuel Technology Handbook, WIP Renewable Energies, 2007.
Energy Indicators for Sustainable Development: Guidelines and Methodologies, IAEA, 2005.
Reducing Greenhouse Gas Emission - The Potential of Coal, IEA, 2005.

Gas Turbines – Selected topics

ID: PhD-3370
teaching professor: Petrović V. Milan
ECTS credits: 5

goals

1. The achievement of research and expert competence in the field of gas turbines.
2. The achievement of high level of theoretical knowledge
3. The acquisition of research and expert knowledge to optimize gas turbines.
4. The achievement of the techniques of process modeling.
5. Mastering the methods of experimental work in thermal power engineering.

learning outcomes

1. Expert and research deep knowledge of gas turbines.
2. The development of critical thinking about energy use, fuel efficiency and environmental preservation
3. The ability of calculate gas turbines.
4. Ability to use computer technology for modeling and calculations

theoretical teaching

Introduction. Application of gas turbines. Thermodynamic background. Thermodynamic cycles and thermal scheme. The basic and main thermodynamic parameters. The influence of basic parameters on the performance. Thermodynamic improvements. Advanced and complex thermodynamic cycles and schemes for gas turbines power plants.
Energy and exergy analyses of the gas turbine plants. The design of gas turbines. Cooling of turbine blades. Combustion chambers. Performance of gas turbines. Regulation of gas turbines.
Project: Heat balance calculation. Energy and exergy analysis.

practical teaching

Project: Heat balance calculation. Energy and exergy analysis.

prerequisite

PhD student - Thermal power engineering.

learning resources

Literature. Computing facility.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Petrovic, M: Gas turbines and Turbocompressors, scrip, 2004.
Stojanovic, Themal Turbomachinery, Gradjevinska knjiga, Belgrade, 1967.
Traupel,W.: Thermische Turbomaschinen, Springer verlag, Berlin, 1982
Cumpsty, N.A , Compressor Aerodynamics, 1989 Longman Scientific and Technical, 2004
Krieger, 2004
Cohen, H., Rogers,G.F.C., Saravanamuttoo, H.I.H.: Gas turbine theory, Logman, 1997.

Heat and mass transfer - numerical approach

ID: PhD-3014
teaching professor: Banjac J. Miloš
ECTS credits: 5

goals

Students should get acquainted with possibilities and gain knowledge of the theoretical basis of the finite volume method. They should to educate for using numerical methods for solving problems in the area of fluid mechanics and area of heat and mass transfer.
Regardless of the complexity of the problem - geometry and boundary conditions, the acquired knowledge will enable them to calculate velocity field, temperature field and field of concentration of some substance in fluids or/and in solids in which these processes are occurred .

learning outcomes

After the course and after independently performed numerical examples, students would have fundamentals knowledge of the theoretical of numerical methods used to solve problems in the field of fluid mechanics and field of the heat and mass transfer.
Also, they would be able to make predictions, i.e. computer simulations of fluid flow and transport of heat and mass by using commercial CFD program PHOENICS 3.1.

theoretical teaching

1. Introduction - comparison of classical and numerical approach for solving problems of fluid flow and problems of heat transfer and transfer of substance
2. Governing equations of fluid flow, heat and substance transfer and equations of state
3. Turbulence and its modeling
4. Two equation models and full Reynolds stress turbulence models
5. The finite volume method for diffusion problems
6. The finite volume method for convection-diffusion problems
8. Solution Algorithms for Pressure-Velocity Coupling in Steady Flows
8. The Finite Volume Method for Unsteady Flows
9. Implementation of Boundary Conditions
10. Solution of Discretised Equations
11. Advanced topics

practical teaching

1. Examples of numerical solving steady state diffusion problems by finite volume method
2. Examples of numerical solving transient diffusion problems by finite volume method
3. Examples of numerical solving steady state convection-diffusion problems by finite volume method
4. Examples of numerical solving transient convection-diffusion problems by finite volume method

prerequisite

Passed exam in the following subjects:
1.1 Advanced course in mathematics
1.2 Numerical Methods
2.1 Selected chapters from Fluid Mechanics

learning resources

1. Handouts and presentations
2. PHOENICS Documentation
3. PHOENICS-related lectures POLIS
4. PHOENICS On-Line Information System

number of hours

lectures: 35
research: 0

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): 40

references

Stevanović, Ž.: Numerical aspects of the transfer of momentum and heat, ISBN. 978-86-80578-81-3, Faculty of Mechanical Engineering, University of Nis, 2004.
Sijerčić, M.: Mathematical modeling of complex turbulent transport processes, ISBN 8678770058, Library of science-research achievements, 9788678770050, Yugoslav Society of Thermal Engineers, 1998.
Patankar, S.V.: Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation, USA, 1980

Heat Transfer Through Building Envelope

ID: PhD-3368
teaching professor: Todorović N. Maja
ECTS credits: 5

goals

The goal of the course is to master the knowledge related to the heat transfer through the building envelope in winter and summer conditions. Acquiring knowledge about the mechanisms of heat transfer and energy balance of the building. Knowledge of general comfort conditions and climatic parameters which disturb the thermal parameters of the environment.

learning outcomes

The outcome of the course is acquired knowledge about mathematical modeling of heat transfer through building elements (walls, ceilings, roofs, floors, windows and doors), the numerical solution of the equations of unsteady heat transfer and analysis of key parameters influence.

theoretical teaching

Mechanism of heat flow – conduction, convection and radiation; One-dimensional heat conduction throughout the walls; Boundary conditions; Multilayers and contact resistance concept; Steady-state conduction without generation; Phisical properties of the construction materials; Heat bridges; Forced convection over a walls and wind influence; Free convection on a walls, floor and ceiling; Unsteady heat conduction – transient temperature and heat flow in a slab – analitical and numerical solutions; Radiation laws and properties of surfaces; View-factor determination; Low-temperature radiation heat exchange inside the room; Sun radiation; Mathematical model of transient heat transfer through building envelope.

practical teaching

Practical classes consist of auditory training with examples of calculations, and independent tasks that students are dealt with; Especially in the field related to different mechanisms of heat exchange.

prerequisite

Previously acquired knowledge of thermodynamics, fluid mechanics, HVAC systems in buildings.

learning resources

Handouts

number of hours

lectures: 35
research: 0

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): 21

references

M. N. Todorović: Handouts
J. A. Adams, D. F. Rogers: Computer - Aided Heat Transfer Analysis

Helicopter Rotor Aerodynamics

ID: PhD-3180
teaching professor: Mitrović B. Časlav
ECTS credits: 5

goals

The aim is to provide the optimal design of the main rotor modeling of unsteady lift through a series of entities which are geared toward the preliminary and main rotor helicopter project. Thus, through the this course processed model of the concept of optimal aerodynamic rotor design that matches the behavior of the rotor in real terms, and that is enough quality in terms of engineering applications. Consideration of the actual rotor in this course can be applied with sufficient accuracy in the analysis and constructive performance rotor helicopter in realistic conditions.

learning outcomes

The ability to deal with scientific research. Student's ability to create and prepare scientific publications. Ability to organize and monitor research projects. Students will be focused on the use of modern aerodynamic analysis, which is also open to the possibility of using available computer techniques circumvent the often unnecessary and very expensive experiment.

theoretical teaching

1.General Features of Flow Field
2.Decomposition of Flow Field
3.Flow Around the Rotor Blades
4.Modeling Wake
5.Vortex Methods of Flow Simulations
6.Helicopter Rotor Aerodynamic Characteristics in Level Flight
7.Helicopter Rotor Aerodynamic Characteristics in Vertical Climbing
8.Aerodynamic Characteristics Helicopter Rotor on Hover
9.Helicopter Rotor Aerodynamic Characteristics when Climbing Angle

practical teaching

Students from each topic given homework to the teacher who submitted the assessment. At the end of lectures students presented their the project. The quality of the paper and the final presentation of the project are determine for the final exam

prerequisite

No preconditions

learning resources

Computer lab, licensed software, projector, laptop

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 0; calculation tasks: 0; seminar works: 30; project design: 40; final exam: 25; requirements to take the exam (number of points): 0

references

Časlav Mitrovic, Modeling of Unsteady Helicopter Rotor Lift, Faculty of Mechanical Engineering, 2002
Jacob Shapiro, Principles of Helicopter Engineering, McGRAW HILL BOOK CO.INC

High speed craft

ID: PhD-3228
teaching professor: Radojčić V. Dejan
ECTS credits: 5

goals

Types of unconventional high speed craft, their hull form etc.
Characteristics of some high speed craft.
Fundamentals of ship hydrodynamics from the aspect of ship resistance and propulsion

learning outcomes

Knowledge about types of high speed craft
Knoledge about some characteristics of high speed craft
Ability to do calculate/evaluate resistance and propulsion of high speed craft.

theoretical teaching

High speed craft (semidisplacement, planing, hydrofoils, hovercrafts, catamarans etc.), form characteristics, determination of resistance and propulsion, model experiments, methods that substitute experiments, dynamic instability etc.

practical teaching

Student should evaluate resistance and/or propulsion within project on the high speed craft.

prerequisite

Report should be defended

learning resources

Extracts from lectures (handouts)
Instructions for project design
The Internet resources etc.

number of hours

lectures: 35
research: 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: 0; project design: 100; final exam: 0; requirements to take the exam (number of points): 100

references

P. de Cane, High Speed Small Ceaft
P. Faltisen, Hydrodynamics of High Speed Marine Vehicles

Hydraulic mashines model and prototype tests

ID: PhD-3190
teaching professor: Nedeljković S. Miloš
ECTS credits: 5

goals

The main aim of these lectures is to refer the doctoral students in the knowledge field of hydraulic turbines, pumps and funs model and prototype testing.

learning outcomes

Getting the necessary knowledge for the turbines, pumps and fans characteristics determination.

theoretical teaching

1. Test rigs for turbine model testing.
2. Methodology and its specifics at tubrine model energy and cavitation characteristics determination. International standards. Particular researches.
3. Measurement of physical quantities required for the determination of turbines characteristics.
4. Measuring devices and their calibration.
5. Characteristics of the turbine models and their specifics.
6. Methods of testing prototypes built in hydroelectric plants.
7. Test rigs for pump models.
8. The methodology for determining energy and cavitation characteristics of pump models and prototypes.
9. Pump characteristics and their specifics.
10. Recalculation procedures of the model turbines and pumps universal characteristics to the prototype operation characteristics.
11. Fun tests in laboratory and in site. Test installation. Fans characteristics.
12. Determination of measuring physical quantities uncertainty for: turbines, pumps and fans.

practical teaching

Laboratories measurements. Turbine/pump/fan tests

prerequisite

MSc diploma

learning resources

Printed lectures. Hand-outs. Laboratory installations. Measuring devices.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

of points): 30

references

IEC 60193 Hydraulic turbines, storage pumps and pump turbines - Model acceptance tests
IEC 41 Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pum turbines
ISO 5198:1987 Centrifugal, mixed flow and axial pumps – Code for hydraulic performance tests – Precision Class
ISO 5801:2007 Industrial fans - Performance testing using standardized airways

IC engines dynamic problems

ID: PhD-3285
teaching professor: Tomić V. Miroljub
ECTS credits: 5

goals

The aims of the course are to provide theoretical and practical study about dynamic behavior of the engine mechanism. The analysis of engine dynamics problems such as: balancing of inertia forces and their moments, crankshaft angular speed variations and crankshaft torsion vibrations require analytical approach, mathematical modelling of the phenomena and experimental testing in order to identify unknown parameters and verify analytical results.

learning outcomes

The merger of theoretical knowledge of mechanics, basics of strength of constructions and machine elements and its applications on specific problems of engine dynamics. Training students for mathematical modeling of engine mechanisms dynamic as well as for experimental testing of phenomena originating from engine dynamics: crankshaft angular speed variations and crankshaft torsion vibrations.

theoretical teaching

1. Dynamic equations of engine crankshaft motion. Mass moment of inertia of crank mechanism; variability of mass moment of inertia and its influence on crankshaft motion. Torques influencing crankshaft motion: gas force torques; inertia forces torques; friction torques; external load torques. Methods of crankshaft rotational speed variability reduction. Possibilities of engine working process diagnostics based on the measurement of crankshaft rotational speed variability.
2. Engine crank mechanism as torsional vibrations system. Equivalent torsional system; reduction of system elements masses and lengths; degrees of freedom; modes and frequencies of free torsional vibrations. Determination of the free vibrations frequencies based on Holzer method. Forced torsional vibrations; harmonic analysis of forcing torques; system resistances and damping; main harmonics of forcing torque, resonance and critical engines rotational speeds. Technical possibilities of torsional vibration damping; torsional vibration dampers. Evaluation of amplitudes and stresses of resonant torsional vibrations.

practical teaching

1.Evaluation of variable mass moment of inertia of engine crank mechanism; practical examples.
2.Gas, inertia and friction forces torques evaluation. Crankshaft rotational speed evaluation.
3. Experimental measurements of engine angular speed. Possibilities of experimental errors evaluation and their elimination.
4. Connections between angular speed variations and engine working process and the possibilities of diagnostics based on angular speed measurements.
5. Practical examples of engine crank mechanism equivalent torsional system evaluation (reduction of system masses and lengths). Evaluating of free torsional vibrations frequencies.
6. Forcing torques and their main harmonics evaluation. Engine critical rpm evaluation.
7. Experimental measurements of engine crankshaft torsional vibrations.

prerequisite

No prerequisites required.

learning resources

1. M.C. Živković: Internal combustion engines, part 2. Engine design 1, Kinematics and dynamics of piston mechanism. Faculty of Mech. Eng., Belgrade, 1983.
2. J.P Den Hartog: Mechanical Vibrations, New York Toronto London McGROW-HILL Book Company, 1956.
3. M.Tomić: Engine design 1-Handouts, available in PDF format in IC engines department.
4.Test bench or engine testing; angular encoders for front and rear crankshaft end. Computer acquisition system for high speed measurements; system of pressure traducers and amplifiers for in-cylinder pressure recordings.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0; test/colloquium: 0; laboratory exercises: 10; calculation tasks: 0; seminar works: 70; project design: 0; final exam: 20; requirements to take the exam (number of points): 60

references

M.C. Živković: Internal combustion engines, part 2. Engine design 1, Kinematics and dynamics of piston mechanism. Faculty of Mech. Eng., Belgrade, 1983.
H. Maaß and H. Klier,Kräfte, Momente und deren Ausgleich in der Verbrennungskraftmaschine. Wien: Springer, 1981.
H. Maaß and H. Klier:Theorie der Triebwerksschwingungen der Verbrennungskraftmaschine, Springer, 1985.
H. Maaß and H. Klier:Torsionsschwingungen in der Verbrennungskraftmaschine, Springer, 1985.
A. S. Rangwala, Reciprocating Machinery Dynamics. New Age International, Jan. 2006.

Impact Mechanics

ID: PhD-3201
teaching professor: Pavišić N. Mirko
ECTS credits: 5

goals

The aim is that the issue of mechanical impact (collision) procedures as wide, and point out the methods of describing processes occurring in the solid body in a short time period of collision, including aspects from the standpoint of classical mechanics, the contact stresses and strains, wave propagation phenomena and occurrence of plastic deformations.

learning outcomes

This course presents a spectrum of different theories for collision and describes where each is applicable. Students will find the methods presented in this course very useful in calculating the response of mechanical systems to impact.

theoretical teaching

Introduction. Analysis of low speed impact. Rigid body theory for collinear impact. Rigid body theory for planar or 2D collisions.3D impacts og rough rigid bodies. Rigid body impact with discrete modeling of compliance for the contact region. Continuum modeling of local deformation near the contact area. Axial impact on slender deformable bodies. Impact on assemblies of rigid elements. Collision against flexible structures. Special problems in impact mechanics.

practical teaching

Introduction. Analysis of low speed impact. Rigid body theory for collinear impact. Rigid body theory for planar or 2D collisions.3D impacts og rough rigid bodies. Rigid body impact with discrete modeling of compliance for the contact region. Continuum modeling of local deformation near the contact area. Axial impact on slender deformable bodies. Impact on assemblies of rigid elements. Collision against flexible structures. Special problems in impact mechanics.

prerequisite

Defined by the curriculum study of Phd studies program.

learning resources

[1] Pavišić,M., Golubović,Z., Mitrović,Z. Mechanics - Dynamics of mechanical systems, Faculty of Mechanical Engineering, Belgrade, 2011.

[2] Stronge W.J. Impact Mechanics - Cambridge University Press, Cambridge, 2004.

number of hours

lectures: 35
research: 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: 60; project design: 0; final exam: 40; requirements to take the exam (number of points): 50

references

Goldsmith W., Impact, Dover Publications, N.Y., 2001.
Пановко.Я.Г., Введение в теорию механического удара, Наука, Москва, 1977.
Johnson K.L., Contact Mechanics, Cambridge Unev. Press, 1985.

Industrial Design

ID: PhD-3350
teaching professor: Spasojević-Brkić K. Vesna
ECTS credits: 5

goals

Through this course students are encouraged to learn to develop and survey new products and experience typologies within the context of current and emerging human needs.Objectives of this course are:
• to increase awareness of the need for and role of ergonomics in occupational health
• to obtain scientific knowledge in the application of ergonomic principles to design of industrial workplaces and the prevention of occupational injuries
• to understand and apply scope of occupational ergonomics.

learning outcomes

Students during this course will learn about: a) the design of things that people use, intentionally taking into account how people operate—including group decision-making; and b) the systems approach. These themes will be examined in a range of contexts, from the operation of everyday things to extraordinary systems failures, so that after the course students will be able to make human centered design projects and survays.After successfully completing this course students should be able to:
1 Assess and discuss the overall value of applying human factors concepts to improve the safety & efficiency of complex systems.
2 Demonstrate mastery of appropriate Human Factors Engineering methods, theories and concepts.
3 Critically analyse the role of human factors in complex systems. In particular, students should be aware of the critical contribution of human factors to the successful design and operation of safety critical systems.
4 Demonstrate independent and creative application of human factors concepts to real world situations.
5 Critically evaluate equipment design features and successfully communicate possible countermeasures for problem areas identified.

theoretical teaching

1. Introduction to Human Factors Engineering
2. Equipment design: human machine interaction, new technologies, usability, standardisation, automation & behavioural responses.
3. User-Centered Analysis and Conceptual Design
4. Practical Usability Testing
5. Risk Factors
6. Anthropometry and Workplace Design
7. Ergonomics standards and regulations
8. Ergonomics Assesment Methods
9. Human Errors, Accidents and Investigation
10. Safety management systems and safety culture
11. Human Factors, Management & Organisation

practical teaching

Examples of User-Centered Design. Case studies with aim to recognize and construct proper recommendations to correct human factors defficiencies in human-machine systems. Design, conduct, and document a human factors experiment or study for a research project.

prerequisite

Enrolled semester.

learning resources

1. Guastello, S. J. (2006) Human factors engineering and ergonomics: A systems approach. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
2. Norman, D. A. (2002). The design of everyday things. New York: Basic Books.
3. Sanders, M.S. and McCormick E.J. (1997). Human Factors in Engineering and Design (7th Ed.)McGraw-Hill, Inc.
4.Kroemer, K.H.E., Kroemer, H.B., and Kroemer-Elbert, K.E. (2001). Ergonomics: How to Design for Ease and Efficiency (2nd Ed.). Upper Saddle River, New Jersey: Prentice Hall.
5. Salvendy, Gavriel: Handbook of human factors, Wiley, New York (1987).
6. Slides from Lectures
7. Scientific papers from Scopus, Science Direct and other databases.

number of hours

lectures: 35
research: 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: 0; project design: 50; final exam: 50; requirements to take the exam (number of points): 25

references

Guastello, S. J. (2006) Human factors engineering and ergonomics: A systems approach. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
Norman, D. A. (2002). The design of everyday things. New York: Basic Books.
Sanders, M.S. and McCormick E.J. (1997). Human Factors in Engineering and Design (7th Ed.)McGraw-Hill, Inc.
Kroemer, K.H.E., Kroemer, H.B., and Kroemer-Elbert, K.E. (2001). Ergonomics: How to Design for Ease and Efficiency (2nd Ed.). Upper Saddle River, New Jersey: Prentice Hall.
Salvendy, Gavriel: Handbook of human factors, Wiley, New York (1987).

Industrial energetics and high temperature processes and devices

ID: PhD-3263
teaching professor: Stanojević M. Miroslav
ECTS credits: 5

goals

The course teaches the students to acquire knowledge about plants and industrial processes, energy and opportunities for improving energy efficiency in industry. In addition, students need to acquire knowledge and methodology for the analysis, modeling and optimization of high temperature processes that are present in many industrial sectors with intensive energy consumption.

learning outcomes

Mastering the knowledge and tools for research and practice to increase energy efficiency in industry; application of methodology for modeling and optimization of high temperature processes in certain industry sectors

theoretical teaching

Basic concepts of energy efficiency and how to use energy in production processes in the industry (the definition of energy efficiency of energy systems in industrial plants, energy companies balance, energy indicators, energy policy). The total number of lecturing hours: 5

Review of high temperature processes and devices in specific industrial sectors (Industrial furnaces, boilers, combustion systems). Resources and measures to increase energy efficiency in industry (Overview of potentials and measures in energy and production systems). The total number of lecturing hours: 8

Presentation of methods for modeling and optimization of high temperature processes (combustion, heat transfer in the furnaces, heating of materials, modeling of processes in industrial furnaces, energy balance). The total number of lecturing hours:: 8

The total number of lecturing hours: 21

practical teaching

Students work under the supervision of teacher one seminar paper that needs student to apply knowledge gained from modeling and optimization of high temperature processes. The paper should include a description and analysis of selected industrial process and presentation of measures to increase the energy efficiency of the analyzed process.

The total volume of exercises: 12 hours

prerequisite

Passed the subject of Thermodynamics

learning resources

Antić, M., Jankes, G., Kuburović, M., Stanojević, M, Karan, M., Petrov, A.: Industrial fournaces (Chapter 4), Handbook of Thermal Engineering , Poslovna politika, Belgrade, 1992., p.79-208., ISBN 86-7007-017-0

Industrial furnaces and boilers and related installations and measuring devices.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 40; requirements to take the exam (number of points): 40

references

Antić, M., Jankes, G., Kuburović, M., Stanojević, M, Karan, M., Petrov, A.: Industrial fournaces (Chapter 4), Handbook of Thermal Engineering , Poslovna politika, Belgrade, 1992., p.79-208.
Jankes, G, Stanojević, M., Stamenić, M.: Industrial fournaces and boilers, II revised edition, Mecanical faculty University of Belgrade, Belgrade, 2001, p. 275., ISBN 86-7083-416-6

Industrial robots modelling and simulations

ID: PhD-3164
teaching professor: Milutinović S. Dragan
ECTS credits: 5

goals

The student should acquire basic knowledge in modelling and simulation of industrial robots kinematics, dynamics, calibration, programming and application.

learning outcomes

Capability to perceive the importance of modelling and simulation of industrial robots kinematics, dynamics, calibration, programming and application. Introduction with actual methods, technics, and software in the field of industrial robots. Practical knowledge and experiences in industrial robots modelling and simulation.

theoretical teaching

Kinematics and dynamics modelling of serial, parallel and hybrid industrial robots. Robot calibration. Off-line robot programming. Program simulation and verification.
Configuring, modelling, and simulations of robotized cells and robotized workplaces.

practical teaching

Laboratory exercises are related to the theme of the PhD thesis and include: kinematics and dynamics robot modellidg, calibration, program simulation and verification, modelling and simulations of robotized cells.

Practical research in the field of modelling and simulation of industrial robots related to the theme of the PhD thesis.

Writing seminar work in the field of modelling and simulation of industrial robots related to the theme of the PhD thesis.

Publication of research paper.

prerequisite

Undergraduate or Master course in the field of Industrial robotics.

learning resources

The Course site (http://cent.mas.bg.ac.rs/nastava/ir_msc/index.htm) containing references and addresses of robot manufacturers and respective institutions (IFR, RIA, JARA, CIRP...).

Laboratory for Industrial robotics and artificial intelligence (Robotics & AI), with 5 industrial robots, robot languages PASRO and software for simulation and programming WORKSPACE 5 and teaching aids.

Center for parallel kinematic machines (CeMPK) with two parallel kinematic machine tools and DELTA robot.

Matlab, Autodesk Inventor, Pro/ENGINEER.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Parallel Robots, J. - P. Merlet, Kluwer Academic Publishers, 2000.
Introduction to Robotics in CIM Systems, fourth Ed., J. A. Rehg, Prentice Hall, 2000.
Industrial Robots Programming, Building Applications for the Factories of the Future, N. Pires, Springer, 2007.
Computer - Aided Manufacturing, Third Edition, T -C. Chang, R. A. Wysk, H - P. Wang, Prentice Hall, 2006.
Robotic and Automation Handbook, Edited by T. R. Kurfess, CRC Press, 2005.

Industrial ventilation

ID: PhD-3071
teaching professor: Živković D. Branislav
ECTS credits: 5

goals

Capacity development for the individual and team work in the field of industrial ventilation. Development and synthesis of complex technical solutions,related to the Ph.D dissertation.

learning outcomes

PhD student who listenes to and passes this subject is capable to independently observe, formulate and solve problems using modern methods, independently and in a team organize and conduct research, makes objective conclusions and to suggest appropriate solutions in the field of industrial ventilation.

theoretical teaching

Ventilation and air conditioning special-purpose facilities: hospitals, kitchens, shelters, swimming pools, transport vehicles, etc. Industrial ventilation and air conditioning. Specific requirements and technical solutions in specific industries: pharmaceutical, chemical, timber, food, electronics, etc. Coupling with the technological process. The possibility of using waste heat. Calculation of the annual energy consumption for ventilation and air conditioning: the single parameter, multiparameter and detailed methods for hourly based calculations for the whole year. Productivity efficiency and the rational use of energy in ventilation and air conditioning systems. Interface with renewable energy sources and new technologies.

practical teaching

-

prerequisite

There are no requirements

learning resources

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

ASHRAE Handbook - HVAC Applications, ASHRAE Publication Sales, Tullic Circle NE, Atlanta Georgia 2011
ASHRAE Handbook - HVAC Systems and Equipment, ASHRAE Publication Sales, Atlanta Georgia 2008
Alden, J. L.: Design of Industrial Exhaust Systems, New York, Industrial Press, 1970.
Scientific and technical papers related to the specific topics

Information Management

ID: PhD-3346
teaching professor: Misita Ž. Mirjana
ECTS credits: 5

goals

Acquisition of skills necessary for independent design or participation in the team for design of information flow

learning outcomes

Students are expected to be able to apply the obtained knowledge for solving problems in design of information flows in companies.

theoretical teaching

1. Introduction into the information management, information flows diagrams 2. Structured Systems Analysis (SSA), SSADM methodology 3. Object oriented analysis. Development of a conceptual model. Development of a sequence diagram. Development of completed class diagrams. Development of a state diagram. 4. Computer systems analysis 5. CASE-tools for systems analysis. Decomposition of computer systems 6. Methodology of design of information systems. Planning and phases. Defining the goal, analysis, global design of information systems. 7. Communications of factories of the future. Communications in complex companies. Electronic and mobile conducting of business.

practical teaching

A case-study from the field of design of information flows diagrams.

prerequisite

Enrolled 2nd semester of doctoral studies.

learning resources

On-line electronic database for academic purpose, Software packages for design of information diagram flows

number of hours

lectures: 35
research: 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: 80; final exam: 10; requirements to take the exam (number of points): 30

references

Maynard, H.B, , 1971, Industrial Engineering Hadbook, McGraw Hill, New York, third edition, pp.1532
urban E., Aronson E.J., Information technologies for management, Institute for textbook publishing and teaching aids, Belgrade, 2003.

Integrated Management Systems

ID: PhD-3142
teaching professor: Majstorović D. Vidosav
ECTS credits: 5

goals

Detailed study of standardized management system (SMS). Generating knowledge for practical application of standardized management systems in everyday engineering practice. Developing skills for research in the field of standardization of business.

learning outcomes

After completion of the teaching process, students will have the necessary knowledge to understand, study and solve problems related to modern approaches to standardized management system (SMS), based systematic approach to business and technology systems. Knowledge of this subject will also enable students to manage the process of organization of the economy, using the scientific method, and the demands of business in the markets of the EU and developing countries in relation to standardized management systems.

theoretical teaching

Standardization of business and its development. Standards of ISO 9000, ISO 14000, OHSAS 18000, ISO 22000, ISO 26000, ISO 27000, ISO 28000, ISO 29000, ISO 31000, ISO 17000, ISO 17043, ISO 19011 and others. Integration and SMS integration models. The design, implementation and evaluation of SMS. European directives. Selected examples of application. Our research in this area. Research problems in this area.

practical teaching

Analysis and synthesis of SMS requests. Analysis of good practices SMS. Scientific approach to the analysis of the application of SMS. The concept of research work for SMS.

prerequisite

Faculty degree, primarily technical.

learning resources

1. Lectures for each lesson in electronic form (handouts).
2. Textbook Integrated management systems (in preparation).
3. Website to material objects under 1 includes a bibliography of reference books and magazines, leading organizations and major institutions in this area.
4. Technical base case - Laboratory for Production Metrology and TQM, which has the necessary equipment and licensed software for training in this subject.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

of points): 30

references

Wiele, T., Advanced Quality Management, Springer Verlag, London, 2009.
Majstorovic, V., Integrated Management Systems, Mechanical Engineering, Belgrade, 2012.

Integration of smart actuators and sensors

ID: PhD-3205
teaching professor: Petrović B. Nebojša
ECTS credits: 5

goals

Smart materials are materials that have properties that can be significantly changed in a controlled fashion by external stimuli. Such materials can be used for detection and activation, thus making the smart actuators and sensors. Due to their compact size and unique properties they have applications in aerospace industry, robotics, biotechnology....
The goal of this course is to expose the students to the principles of smart materials with an emphasis on their use and integration in aerospace applications.
Students will be introduced to smart material fundamentals, their thermo-mechanical and elektro-magnetic properties and couplings between these fields. During the course topics concerned with design, modeling, control and fabrication of smart structures are presented and various examples are demonstrated. Through exercises, students will explore potentials of smart actuators and sensors and challanges associated with their uses.

learning outcomes

During the course, students will acquire the knowledge necessary for understanding the fundamental behavior of smart materials. They will be introduced to the mathematical models that describe the behavior of smart materials and to the principles of smart sensors and actuators construction. Also, by experimenting with different types of smart structures control algorithms during the practical part of the course, students will gain experience and operational knowledge that can be utilized in real life applications throughout their career.

theoretical teaching

Introduction to Smart Materials,
Piezoelectric Materials and Magnetostrictive Materials constitutive relationship
Smart Actuators and Micromechatronics - Basics, Applications, Current and future trends
Smart Sensors - Basics, Applications, Current and future trends
Integration of Smart Sensors and Actuators to Smart Structures
Optimal Placement of Sensors and Actuators
Design of Controller for Smart Structure

practical teaching

Practical exercises follows the course content. During the exercises the student develops computer models of smart structures, performs numerical analysis and applies different algorithms for control and optimization of smart structure.

prerequisite

There is no necessary requirement for attendance of Integration of smart actuators and sensors.

learning resources

Simlab - computer laboratory

number of hours

lectures: 35

research: 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

Petrović N., Inteligentni piezoaktuatori, Mašinski fakultet Univerziteta u Beogradu, Beograd, 2003.
Janocha H., Adaptronics and Smart Structures: Basics, Materials, Design, and Applications, Springer,.1999.
Inman D., Vibration with control, John Wilez & Sons, 2006.
Selected research articles and conference papers.
Additional materials (written handouts, problem setting, guidelines for problem solving...)

Intelligent Automation

ID: PhD-3207
teaching professor: Petrović B. Petar
ECTS credits: 5

goals

Specialized knowledge in the field of design and realization of industrial automation with embedded elements of artificial / machine intelligence and autonomous behavior, focused to various research topics in the domain of mass customization manufacturing paradigm.

learning outcomes

Practical knowledge and skills in modeling and simulation of dynamical systems. Skills in application of fuzzy logical systems and neural networks in modeling and practical realization of complex systems that have autonomous behavior and capability to work in non-well structured working environment.

theoretical teaching

Modeling and simulation of complex dynamical systems. Fundamentals of selforgnized and selfreproducing systems. Interaction with non-well structured/defined environment – cognitive systems, adaptivity, learning and machine intelligence. Fundamentals of mathematical pattern recognition. Fuzzy-dynamic formal structures, fuzzy inference machines. Connectionism and parallel processing through neural networks of various topology. Industrial control systems with embedded adaptive and intelligent behavior. Intelligent human-machine interfaces. Industrial standards related to intelligent devices and systems. Basics of intelligent manufacturing systems.

practical teaching

prerequisite

Continuous and discrete systems of manufacturing systems control, Numerical control of machine tools and robots, Cybernetics, Mechatronics systems

learning resources

number of hours

lectures: 35
research: 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

Petrović P. B., Inteligentni sistemi za montažu, Mašinski fakultet u Beogradu, 1999.
Kasabov, N. and Kozma, R., (Eds) Neuro-Fuzzy Techniques for Intelligent Information Systems, Springer-Verlag Co. - Phisica-Verlag, Hilderberg New York, 1999, ISBN 3-7908-1187-4.
Kosko, B., Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence, Prentice Hall; June 1991, ISBN-10: 0136114350.
Bolton, W., Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Prentice Hall, 2004, ISBN-10: 0131216333.
Zi-Xing Cai, Intelligent Control: Principles, Techniques And Applications, Series in Intelligent Control and Intelligent Automation: Volume 7, ISBN: 978-981-02-2564-3.

Intelligent industrial robots

ID: PhD-3165
teaching professor: Milutinović S. Dragan
ECTS credits: 5

goals

The student should acquire basic knowledge related to new methods and technics in industrial robots modelling, programming, sensors and intelligence.

learning outcomes

Capability to perceive the importance of industrial robot intelligence. Introduction with actual methods, technics, software, sensors, and sensors fusion in the field of industrial robot intelligence.

theoretical teaching

Modelling of serial, parallel and hybrid industrial robots. Redundant robots. Macro/micro and micro/nano robot structures. Advance basic robots' subsystems. Sensors fusion, vision systems and intelligence. Intelligent path planning. Programming and simulation. Complex industrial tasks and new fields of industrial robot applications.

practical teaching

Laboratory exercises are related to the theme of the PhD thesis and include: sensors fusion, vision systems and intelligent path planning.

Practical research in the field of inustrial robot intelligence related to the theme of the PhD thesis.

Writing seminar work in the field of inustrial robot intelligence related to the theme of the PhD thesis.

Publication of research paper.

prerequisite

Undergraduate or Master course in the field of Industrial robotics.

learning resources

The Course site (http://cent.mas.bg.ac.rs/nastava/ir_msc/index.htm) containing references and addresses of robot manufacturers and respective institutions (IFR, RIA, JARA, CIRP...).

Laboratory for Industrial robotics and artificial intelligence (Robotics & AI), with 5 industrial robots, robot languages PASRO and software for simulation and programming WORKSPACE 5 and teaching aids.

Center for parallel kinematic machines (CeMPK) with two parallel kinematic machine tools and DELTA robot.

Matlab, Autodesk Inventor, Pro/ENGINEER.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Modelling and control of robot manipulators, L. Sciavicco and B. Siciliano, Springer, 2005.
Mechatronics, principles and applications, G. C. Onwubolu, Elsevier, 2005.
Introduction to Robotics, Analysis, Systems, Applications, S. B. Niku, Prentice Hall, 2001.
Robot analysis, The Mechanics of Serial and Parallel Manipulators, Lung-Wen Tsai, John Wiley & Sons, 2003.
Robotics: Control, Sensing, Vision, and Intelligence, Fu K.S., Gonzales R.C., Lee C.S.G., McGraw-Hill, New York, 1987.

Introduction to Scientific Computing Work

ID: PhD-3384
teaching professor: Radojević LJ. Slobodan
ECTS credits: 5

goals

PhD candidate must gain an insight into the preparation and processing of scientific paper in the Computer Science.

learning outcomes

PhD student to gain insight into how publishing paper in Computer Science.

theoretical teaching

1. The study of database records for research papers.
2. Identification papers across DOI.
3. Basic and advanced search methods of the records of scientific papers related to Computer Sience.
4. Definition of TEX-styles which are related to the Computer Science - the first part.
5. Definition of TEX-styles which are related to the Computer Science - the second part.
6. BIBTEX.
7. Create own database with BIBTEX.
8. Customizing TEX то native language.

practical teaching

TEX

prerequisite

The basic arrangement of the computer application.

learning resources

Simplest computer and access to the Internet.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 0; calculation tasks: 0; seminar works: 45; project design: 0; final exam: 50; requirements to take the exam (number of points): 50

references

Learning Management Systems

ID: PhD-3340
teaching professor: Stefanović A. Zoran
ECTS credits: 5

goals

Course enable students to gain a broad understanding of the different learning management systems, learning content management systems, and integrated multimedia learning platforms. It explains informatively about the world of distance education and how different platforms are used in e-Learning, distance education and online training. In addition, it experience in using different software platforms and reach to conclusions about the benefits and drawbacks of the systems.

learning outcomes

At the end of Course students will be able to: Integrate instructional design models to e-Learning, distance education and online training; differentiate between static models of instructional design and dynamic designs based on dialog and building learning communities; compare and contrast synchronous and asynchronous learning; use basic functions of an LMS, LCMS or IMMS (integrated multimedia management system); utilize different tools within the design & delivery of online training, eLearning and distance courses evaluate different types of communication among students in online, e-Learning, & distance courses within different software platforms; differentiate between Learning Management Systems, Content Management Systems, Learning Content Management Systems, and integrated multimedia systems; select an appropriate platform for a particular learning, training or performance development system; determine the benefits and drawbacks of different learning/content management systems and other distance learning platforms

theoretical teaching

The course introduce students to software platforms that are commonly used in e-Learning, distance education and online training. Instructional design models applied to using these tools in corporate training and performance development, developing lessons in schools and creating courses in higher education is presented and discussed and are implemented in hands-on projects. Furthermore, this course demonstrates the differences between learning management systems, learning content management systems, and integrated media platform systems and will specify their appropriate use.

practical teaching

prerequisite

none

learning resources

This Course has a virtual classroom on the Internet. At the first lecture students are enrolled and trained for work (Moodle software). In the workshop approach is performed with the lectures and exercises, guidelines for project design, internet resources, etc.

number of hours

lectures: 35

research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Zoran Stefanović, Zoran Milljković: Handouts for Learning Management Systems, Faculty of Mechanical Engineering, 2010.
Abdelmonim Awad Osman: Learning Management Systems, Lambert Academic Publising, 2010
Yefim Kats: Learning Management System Technologies and Software Solutions for Online Teaching, IGI Global Snippet, 2010

Load distribution - Analysis and Synthesis - 1

ID: PhD-3240
teaching professor: Ristivojević R. Mileta
ECTS credits: 5

goals

Acquiring knowledge in the area of machine elements load distribution (gears, bearings, threaded joints, chain transmission,...) regarding efficiency and operational capability. Knowledge and skils improvement. Synthesising the acquired knowledge and skills with previously acquired knowledge. Establishing a correlation between the intensity of the load to be transferred and stiffness and accuracy of composite parts in order to achieve proper load.

learning outcomes

Students will be able to: use the scientific literature on selected areas from the scope of Course; independently solve a scientific-research problems from selected area (making of appropriate analytical, numerical and experimental models); individually or as a team member, to write scientific research papers; ability to transfer knowledge and skills to others.

theoretical teaching

Gear pairs load distribution. Load distribution on the coupled pairs of gear's teeth. Defining of load distribution analytical model. Boundary load distribution (uniform and uneven) and real load distribution. Influence factors. Contact line lenght analysis regarding to load distribution uniformity. Boundary conditions defining. Influence of load intensity, stiffness and gear teeth production accuracy on load distribution in operational conditions. Load distribution influence on gear teeth capacity. Rolling bearing load distribution. Load distribution between rolling bearing compšonents. Boundary load distributions. Influence factors. Influence of load intensity, stiffness, radial clearance and number of rolling bodies on load distribution. Influence of load distribution on rolling bearing's service life and capacity.

practical teaching

prerequisite

-

learning resources

Laboratories of Machine design, University of Balgrade, Faculty of Mechanical Engineering. Handouts, Presentations, Wireless Internet connection and access to the course Web presentation provided with usefull links.

number of hours

lectures: 35
research: 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: 75; project design: 0; final exam: 25; requirements to take the exam (number of points): 0

references

M.Ristivojević, R.Mitrović: Load Distribution - Gear Pairs and Rolling bearings, Belgrade, 2002.
Karl-Heinz Decker: Machinenelemente: Funktion, Gestaltung und Berechnung, Hanser Verlag, 2000
R.Mitrovic: PhD thesis, Faculty of Mechanical Engineering University of Belgrade, 1992.
M.Ristivojevic: PhD thesis, Faculty of Mechanical Engineering University of Belgrade, 1991.

Load distribution - Analysis and Synthesis - 2

ID: PhD-3176
teaching professor: Mitrović M. Radivoje
ECTS credits: 5

goals

Acquiring knowledge in the area of machine elements load distribution (gears, bearings, threaded joints, chain transmission,...) regarding efficiency and operational capability. Knowledge and skils improvement. Synthesising the acquired knowledge and skills with previously acquired knowledge. Establishing a correlation between the intensity of the load to be transferred and stiffness and accuracy of composite parts in order to achieve proper load.

learning outcomes

Students will be able to: use the scientific literature on selected areas from the scope of Course; independently solve a scientific-research problems from selected area (making of appropriate analytical, numerical and experimental models); individually or as a team member, to write scientific research papers; ability to transfer knowledge and skills to others.

theoretical teaching

Gear pairs load distribution. Load distribution on the coupled pairs of gear's teeth. Defining of load distribution analytical model. Boundary load distribution (uniform and uneven) and real load distribution. Influence factors. Contact line lenght analysis regarding to load distribution uniformity. Boundary conditions defining. Influence of load intensity, stiffness and gear teeth production accuracy on load distribution in operational conditions. Load distribution influence on gear teeth capacity. Rolling bearing load distribution. Load distribution between rolling bearing compšonents. Boundary load distributions. Influence factors. Influence of load intensity, stiffness, radial clearance and number of rolling bodies on load distribution. Influence of load distribution on rolling bearing's service life and capacity.

practical teaching

prerequisite

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learning resources

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

number of hours

lectures: 35
research: 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: 75; project design: 0; final exam: 25; requirements to take the exam (number of points): 0

references

M.Ristivojević, R.Mitrović: Load Distribution - Gear Pairs and Rolling bearings, Belgrade, 2002.
Karl-Heinz Decker: Machinenelemente: Funktion, Gestaltung und Berechnung, Hanser Verlag, 2000
R.Mitrovic: PhD thesis, Faculty of Mechanical Engineering University of Belgrade, 1992.
M.Ristivojevic: PhD thesis, Faculty of Mechanical Engineering University of Belgrade, 1991.

Locomotor Bioengineering

ID: PhD-3123
teaching professor: Lazarević P. Mihailo
ECTS credits: 5

goals

Introduce students to the application of fundamental principles and laws of biomechanics of tissue as well as problems of locomotion design of assistive devices to understanding and analyzing them.
Establishment of appropriate biomechanical(rheological) model of tissue using modern theory of viscoelasticity, dynamics of deformable (rigid) body,the possibility of simulations based on them in order to confirm the experimental data, the possibility of applying for the purposes of design and design basis of the same. It allows the potential cooperation with experts in medicine or work in specialized clinical institutions.

learning outcomes

Attending the course students acquire the ability to analyze the possibility of solving the current problems related to the biomechanical properties and characteristics of human tissues and biolocomotor system with the use of scientific methods and procedures as well as computer technology and equipment. In addition, students can connect basic knowledge of mechanics, mathematics, physics, anatomy, physiology, biomechanics with application in the bioengineering of locomotor and tissues.

theoretical teaching

Basics biolocomotor bioengineering.Introduction to the biomechanics of tissues Introduction to continuum mechanics, transport phenomena.
The dynamic behavior of biological tissues: the relaxation of stress, creep, hysteresis.
Introduction to the theory of viscoelasticity (TV): Kelvin-Voigt and Maxwell model. The concept of locomotion, types of locomotions.Kinematics of the human locomotor system (HLS) and motor tasks.Tolerance of tissue to impact loads.
Rheological model of the locomotion mechanism.Biomechanical engineering to prevent tissue trauma. Engineering tissues

practical teaching

Biomechanical properties of hard tissues such as tooth-and bone man. Biomechanical properties of soft connective tissues-such as muscle, the muscle fibers. Examples of dynamic behavior of biological tissues / organs: the stress relaxation, creep, hysteresis. Examples of locomotor motion: walking, running, sports movements. Computer methods and techniquesin biomechanics (FEM, Matlab,...) with the appropriate application. Examples of organ injury, damage to the musculoskeletal system:head and spinal cord-biomechanical models of the same. Tolerance of tissues to impact loads. The growth of tissues - such as bones. Examples of artificial models of tissues.

prerequisite

none

learning resources

[1]Y. C.Fung,Biomechanics:Mechanical Properties of Living Tissues, Springer, Berlin,2000,(KCJ)

[2]Писани изводи са предавања (handouts),
[3]М.Лазаревић, Биомеханика ткива и органа,(скрипта у припреми),2011
[4]Joseph D.Bronzino,«Tissue Engineering and Artificial Organs (The Biomedical Engineering Handbook),CRC Press,2006.(КСЈ)
[5]D.Schneck,J.Bronzino,Biomechanics principles and applications,CRC Press, New York,2003.(КСЈ)
[6]National Instruments-LABVIEW,(ЦСП)
[7]WWWinternetlaboratorije,MATLAB,
[8]R. Magin. Fractional Calculus in Bioengineering. Begell House, Inc. 2006

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

Ed. Joseph D. Bronzino,The Biomedical Engineering HandBook, Second Edition. Boca Raton: CRC Press LLC, 2000
M,Lai,D.Rubin,E.Crempl, Introduction to Continuum Mechanics,Pergamon Press,1993.
C. Oomens, M. Brekelmans, F. Baaijens,Biomechanics: Concepts and Computation,Cambridge University Press,,2009

Low Cycle Fatigue

ID: PhD-3087
teaching professor: Janković D. Miodrag
ECTS credits: 5

goals

Determining of stress-strain behavior by elastic-plastic deformation of the specimen of applied material under the controlled strain amplitudes in form of Basquin-Manson-Coffin's fatigue curves. Determining the stabilized, the corresponding hysteresis loop and stabilized cyclic stress-strain curve. Methods for determining the concentration of stress and strain at the noth root of machine parts and determination of corresponding deformation for the fatigue life calculation.

learning outcomes

Methods for registration and statistical analysis of the working strain at the notch root of components. The determination of fatigue damage and its process flow of its accumulation by using theoretical and experimental methods with appropriate damage hypotheses. Establishment of appropriate criteria for the occurrence of critical fatigue damage phenomena and determination of working fatigue life. The reduction of results for the variable spectra to equivalent results for the full constant strain amplitude spectra.

theoretical teaching

The methodology for statistical presentation of flow variable deformation in the work and its reducing to the spectrum or blocks of the strain. Various hypotheses about the accumulation of fatigue damage and the criteria for critical phenomena occurrence - the crack or fracture in the low cycle fatigue - LCF region. Comparison of some hypothesis with advantages and disadvantages. Palmgren-Miner hypothesis, its assumptions, advantages and disadvantages in the LCF - region. Various modifications of this hypothesis. Other important linear and nonlinear Hipotheses of fatigue damague accumulation. Experimental methods, determining the life and ways of results presenting. Using these results is a basis for setting the generalized linear hypothesis of fatigue damage accumulation. It allows a more accurate determination of the fatigue life under a spectrum the shape of which is similar as a experimental strain spectrum and the fatigue damage intensity of which is different one.

practical teaching

Methods for experimental testing with controlled elastic-plastic strain amplitude with electro-hydraulic pulsator. Standardized forms of test samples, extensometer and other associated equipment. Registration procedures of hysteresis loops during fatigue process, stabilized study state and the determination of cyclic stress-strain curves.

prerequisite

Desirable to repeat the field of classical high cycle fatigue and the basis of the theory of plasticity.

learning resources

Laboratory with testing machines.

number of hours

lectures: 35
research: 0

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): 0

references

Collins, J. A.: Failure in Materials in Mechanical Design, Analisis, Prediction, Prevention, John Wiley & Sons, 1981.
Fuchs, H., O., Stephens, R., I.: Metal Fatigue in Engineering, John Wiley & Sons, 1980.
Dowling, N.E.: Mechanical Behavior of Materials, Engineering Methods for Deformation, Fracture and Fatigue, Pearson Edition, Prentice Hall, Upper Saddle River, 2007.

Lubrication Theories

ID: PhD-3033
teaching professor: Vencl A. Aleksandar
ECTS credits: 5

goals

The student attending this course should:
• Examine the complexities of lubrication process and its importance in the construction of the main tribological elements;
• Get familiar with the standards for the calculation of main tribological elements;
• Learn the basic principles of main lubrication types and how they should be applied in the design process.

learning outcomes

On the basis of mastered knowledge the student is qualified to define the basic assumptions for the calculation of main tribological systems, according to standards, and based on the lubrication theories.

theoretical teaching

The introductory section includes a definition of the lubrication process, forms and types of lubrication and lubricant rheology. Fundamental aspects of lubrication, defined by Reynolds equation, and the study of its solutions: theory of infinite length bearing, short bearing and bearing with finite length. Calculation methods that use hydrostatic, gasostatic, hydrodynamic, gasodinamic and elastohydrodinamic lubrication theory. In particular, boundary and mixed lubrication are studied, including the study of lubricants in these conditions.

practical teaching

prerequisite

learning resources

1. A. Rac, Fundamentals of Tribology, Faculty of Mechanical Engineering, Belgrade, 1991, (in Serbian).
2. A. Rac, Lubricants and Machine Lubrications, Faculty of Mechanical Engineering, Belgrade, 2007, (in Serbian).
3. J. Halling, Principles of Tribology, The MacMillan Press, London, 1975.
4. O. Pinkus, B. Sternlicht, Theory of Hydrodynamic Lubrication, McGraw-Hill, New York, 1961.
5. Y. Hori, Hydrodynamic Lubrication, Springer, Tokyo, 2006.
6. B.J. Hamrock, S.R. Schmid, B.O. Jacobson, Fundamentals of Fluid Film Lubrication, Marcel Dekker, New York, 2004.
7. D. Dowson, G.R. Higginson, Elasto-Hydrodinamic Lubrication, Pergamon Press, Oxford, 1977.

number of hours

lectures: 35
research: 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: 70; project design: 0; final exam: 30; requirements to take the exam (number of points): 35

references

A.Z. Szeri, Tribology: Friction, Lubrication, and Wear, McGraw-Hill, New York, 1980.
D. Dowson, C.M. Taylor, M. Godet, D. Berthe (Eds.), Developments in Numerical and Experimental Methods Applied to Tribology, Butterworths, London, 1983.
W.A. Gross, L.A. Matsch, V. Castelli, A. Eshel, J.H. Vohr, M. Wildmann, Fluid Film Lubrication, John Wiley & Sons, New York, 1980.
O.R. Lang, W. Steinhilper, Gleitlager, Springer, Berlin, 1978.
S. Bair, High Pressure Rheology for Quantitative Elastohydrodynamics, Elsevier, Amsterdam, 2007.

Maintenance and Quality Management System

ID: PhD-3261
teaching professor: Spasojević-Brkić K. Vesna
ECTS credits: 5

goals

The aim of this course is to acquire theoretical and practical knowledge in the fields of maintenance and quality management.

learning outcomes

By completing the couse students acquire professional skills in the following fields: 1 maintenance management system design, and 2 Quality Management System Design. At the end of the course, students attach more importance to maintenance and quality management from the point of viability, and are trained to use the methods, techniques and models for maintenance and quality management.

theoretical teaching

1. Importance, organizational factors and maintenance management system 2.Importance, organizational factors and the structure of quality management systems 3. Organizatinal Design Factors and maintainance system 4. The organizational structure of the maintenance function 5. Quality Menagement System and organizational changes 6. Quality management and business performances relationship 7. Integrated Management Systems

practical teaching

Case studies in the areas of theory.

prerequisite

Enrolled semester

learning resources

1. Spasojević Brkić Vesna, Contingency Theory and Quality Management, MNTRS- FME, ISBN 978-86-7089-675-4, 2009.
2. Smith R., Hawkins B., Lean maintenance : reduce costs, improve quality, and increase market share, Elsevier Butterworth–Heinemann, Oxford, UK, 2004
3. Kelly A., Managing Maintenance Resources, Elsevier Ltd., Oxford, UK, 2006
4.Milivoj Klarin,Gradimir Ivanović,Petar Stanojević - Terotechnology (in Serbian) - ICIM Kruševac 2001
5. Spasojević-Brkić, V, Milanovic D, i dr., Quality management System and Business Performances (in serbian),MNTRS- FME,ISBN: 978-86-7083-741-6 ,2012.
6. Scientific papers from Scopus, Science Direct and other databases.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 0

references

Kelly A., Managing Maintenance Resources, Elsevier Ltd., Oxford, UK, 2006
Smith R., Hawkins B., Lean maintenance : reduce costs, improve quality, and increase market share, Elsevier Butterworth–Heinemann, Oxford, UK, 2004
Dr Milivoj Klarin,Dr Gradimir Ivanović,Dr Petar Stanojević - Terotechnology (in Serbian) - ICIM Kruševac 2001
Spasojević Brkić Vesna, Contingency Theory and Quality Management, MNTRS- FME, ISBN 978-86-7089-675-4, 2009.
Spasojević-Brkić, V, Milanovic D, i dr., Quality management System and Business Performances (in serbian),MNTRS- Mašinski fakultet,ISBN: 978-86-7083-741-6 ,2012.

Management of Innovation

ID: PhD-3214
teaching professor: Pokrajac U. Slobodan
ECTS credits: 5

goals

As innovation is crucially important for business growth, it is essential
to establish Innovation Management as a core competency.
The main goal of program of the subject Management of Innovation is preparing students for a management and research career in contemporary dynamic market environment through a management core, combined with advanced insights in innovation and entrepreneurship.
Also, the aim of this program is to help students for innovation within their company to expand their general management and leadership competencies - with a strong focus on the management of technology. In fact, this program will bridge technology, innovation, management and leadership.

learning outcomes

The program enables student to adopt the following subject knowledge and understanding, intellectual and academic skills, practical subject skills, key attributes and transferable skills. The outcomes that it will have demonstrated upon completion of the program, are the abilities to: learn the key principles of innovation management; understand the key issues in managing innovation first of all in manufacturing and service; set a clear direction through the development of an innovation strategy that focuses on creating new products and services that bring sustainable competitive advantage in turbulent market environment.

theoretical teaching

The four main types of innovation: product, service, process and
business innovation.
Global innovation and R&D strategy - Managing emerging technologies -
Technology and development - Service design and innovation -
Sustainable and clean-tech innovation.
Impacts of information technology upon individuals, organizations and
society - Open source innovation - Business model innovation.
Sociological aspects of technology, work and innovation - Knowledge management - Virtual Organizations - Project Management – Technology Assessment and Prognostic -Measures of innovation - The innovation audit.
Intellectual property rights – preparation of a patent - licensing agreements, etc.
State and innovation: international comparison.
International transfer of technology.

practical teaching

The practical work is consisted from discussion and workshops with special topics as well as characteristic industrial cases from local and word practice. Special attention will be paid to the problem of technological innovations as a key factor of competitiveness. Beside that, practical work is used for preparation of seminar paper.

prerequisite

At least 60 points, when points from the practical exam are especially important.

learning resources

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Betz, F. (2003), Managing Technology Innovation: Competitive Advantage from Change, N. Y.
Besant, J., Tidd, J., Pavitt, K., (2001), Managing Innovation, Willey, N. Y.
Ettlie, J., (2006), Managing Innovation: New Technology, New Product and New Services in a Global Economy, Butterworth-Heinemann, London
Trott, P., (2008), Innovation Management and New Product Development, Prentice Hall,

Management of production

ID: PhD-3154
teaching professor: Milanović D. Dragan
ECTS credits: 5

goals

Acquisition of skills necessary for the field of management of production.

learning outcomes

Using the acquired skills and solving problems of management of production by means of the methods and techniques of industrial engineering.

theoretical teaching

1. Goals and tasks of management of production 2. Management of business functions in a manufacturing company 3. Analysis of business functions in a manufacturing company 4. Management of information systems 5. Computer planning and management of production 6. Manufacturing cycle 7. Optimization of internal resources aimed at more efficient management of production 8. A case-study in a manufacturing company

practical teaching

A case-study from the field of management of production.

prerequisite

No specific enrolment requirements.

learning resources

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 25; 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

Bulat, V., Organization of production, Faculty of Mechanical Engineering, Belgrade, 1990.

Man - machine interface

ID: PhD-3075
teaching professor: Žunjić G. Aleksandar
ECTS credits: 5

goals

The goal of this course is to inform students with advanced techniques and recommendations for designing of selected segments from the domain of man - machine interface.

learning outcomes

It is expected that students will gain knowledge that will help them in designing of advanced features related to the man - machine interface.

theoretical teaching

Designing of specific controls. Designing of displays for qualitative and status control. Basic safety aspects of packaging. Injuries caused by inadequate packaging. Packaging of hazardous material. Other safety aspects of packaging. Informational aspect of packaging. Most frequent mistakes relating to the presentation of information. Most frequent mistakes concerning opening of packaging. Forces for opening of packaging. Tools for opening of packaging. Recommendations for designing of ergonomic packaging.

practical teaching

Writing a seminar paper regarding the chosen topic.

prerequisite

Defined by Regulation on doctoral studies.

learning resources

Tachistoscope, sound level meter, konimeter, psychrometer, lux meter, anthropometric measuring equipment, available in the lab. 417.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 0; calculation tasks: 0; seminar works: 65; project design: 0; final exam: 30; requirements to take the exam (number of points): 65

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.
Sanders M. and McCormick E., 1993, Human factors in engineering and design, McGraw - Hill, Singapore.

Mass, momentum and energy transport phenomena

ID: PhD-3268
teaching professor: Stevanović D. Nevena
ECTS credits: 5

goals

The aim of this subject is getting knowledge about fundamental aspects of the transport phenomena (mass, momentum and energy transport) and developing skills for the application to various practical problems.

learning outcomes

Students are trained to develop mathematical models of thermalhydraulic processes, where mass, momentum and energy transport phenomena is coupled and to solve them by analytical and numerical methods.

theoretical teaching

Theoretical lessons incorporates the heat, momentum and mass transfer field which includes studies of convection, radiation, conduction, evaporation, condensation, boiling and two-phase flow in the laminar and turbulent flow, as well as transport phenomena in support of micro-scale and nano-scale sciences.

practical teaching

Practical lessons contains applicationc of the heat, momentum and mass transfer field which includes studies of convection, radiation, conduction, evaporation, condensation, boiling and two-phase flow in the laminar and turbulent flow, as well as transport phenomena occurring in micro and nano-science.

prerequisite

Passed exam in Fluid mechanic and Thermodynamics.

learning resources

Course handouts.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 50

references

Slattery, J.C., Advanced Transport Phenomena, Cambridge University Press, 1999
Bird, R.B.,Stewart, W.E., and Lightfoot, E.N., Transport Phenomena, John Wiley, New York, 2007

Material Science and Engineering

ID: PhD-3220
teaching professor: Prokić-Cvetković M. Radica
ECTS credits: 5

goals

The aim of this course is to present the basic concepts of materials science, and to establish a relation between the structure and properties of materials at the level that is understandable to students who have successfully completed a masters degree. It is expected that upon completion of this course, students have a certain level of knowledge about the behavior of materials under the load on the micro and macro level, and based on the established structure-property relationship of materials properly select appropriate materials in the design of structures.

learning outcomes

After fulfilling all the course requirements, a student is capable to solve concrete problems in the area of Material Science and Engineering 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

-Relationship between structure and materials properties
-Stress and strain relationship during elastic and plastic behavior of material
-Elements of theory of plasticity
-Plastic deformation of monocrystal and polycrystal agregats
-Theory of dislocation
-Strengthening mechanisms
-Fracture
-Materials behavior at lower and elevated temperatures

practical teaching

Consultation

prerequisite

Completed master studies

learning resources

1. G.E.Dieter, Mechanical metallurgy, McGraw-Hill Book Company, (1988).

2. J. Callister, Materials Science and Engineering, John Wiley& Sons, (1985)

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 100; requirements to take the exam (number of points): 0

references

G.E.Dieter, Mechanical metallurgy, McGraw-Hill Book Company, (1988).
J. Callister, Materials Science and Engineering, John Wiley& Sons, (1985)

Mathematical modeling of the process and the apparatus for drying

ID: PhD-3290
teaching professor: Topić M. Radivoje
ECTS credits: 5

goals

Review of mathematical models and numerical methods in the drying process technology.

learning outcomes

Competence to solve questions of modeling and optimization of of the drying process and apparatus.

theoretical teaching

The outstanding resources provides the detailed Information necessary for the development of mathematical models and numerical techniques to solve specific drying problems.
Discusses fundamental modeling strategies and new computational methods as well as new drying techniques, including microwave drying, superheated steam drying and many others.

practical teaching

Laboratory work on the drying kinetics of different materials.

prerequisite

Regulated by the program of study

learning resources

Laboratory installations are located in the Institute. Books in the cabinet 532nd

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Arun S. Mujumdar; Handbook of Industrial Drying, Marcel Dekker, 270 Madison Avenue, New York.
Drying Technology an Intenational Journal, Marcel Dekker, 270 Madison Avenue, New York

Mathematical Modelling of HVAC Systems

ID: PhD-3393
teaching professor: Todorović N. Maja
ECTS credits: 5

goals

The aim of the course is to acquire knowledge about the various HVAC systems in buildings and methods of mathematical modeling of processes in the system.

learning outcomes

The outcome of the course is knowledge related to various HVAC systems, their function and dynamics behavior, and the models of the automatic control mode. The student acquires knowledge about optimization of HVAC systems in buildings

theoretical teaching

Comfort heating and air-conditioning systems; Elements and equipment in HVAC systems(heat sources, distribution network, heating/cooling bodies; working fluids - water, air, refrigerants). Heating systems; Air-conditioning systems; Mathematical modeling of processes in the system; Optimization of HVAC systems; Techiniques for energy savings; Energy consumption calculation; Final and primary energy and CO2 emission.

practical teaching

Practical classes consist of auditory training with examples of calculations, and independent tasks that students are dealt with; Especially in the field related to HVAC systems energy consumption and optimization.

prerequisite

Previously acquired knowledge of thermodynamics, fluid mechanics, HVAC systems in buildings.

learning resources

Handouts and books.

number of hours

lectures: 35
research: 0

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): 21

references

M. N. Todorović: Izvodi sa predavanja
R. C. Jordan, G. B. Priester: Refrigeration and Air Conditioning
G. V. Reklaitis, A. Ravindran, K.M. Ragsdell: Engineering optimization - methods and applications
ASHRAE HANDBOOK: HVAC Systems and Equipment, 2012.

Measurements A- Basics

ID: PhD-3315
teaching professor: Škatarić M. Dobrila
ECTS credits: 5

goals

Aim of this course is to provide basic knowledge in measurement techniques to be applied in mechanical engineering. Particularly, how to measure non electrical quantities by electric means. Some basic knowledge in electrical engineering fundamentals can successfully be applied in this course, such as Ohm's low, temperature characteristics of some conductors, variable capacitors and inductance. Depending of particular interest of a group, different measurements cold be scope of course. Both digital and analog techniques are treated, and basic logic elements are presented. Multiplexing and demultiplexing are described, as well as digital computer as a measurement system tool.

learning outcomes

For students, to know how to perform some techniques and how to recognize problem in practice. To understand the principles of specific measurements, and to know how to explain results. To understand someone else measurements and to know how to compare results. To estimate errors and uncertainties of particular measurements. To calibrate equipment; To design experiment with minimizing errors. To achieve a skills for data transmitting, using standard protocols. Physical understanding and experience lead to creative approach in new, unknown situations.

theoretical teaching

Dimensions, conventions for rounding, presenting experimental data,errors. Instruments, Intro to uncertainty, propagation of uncertainty, minimizing errors in designing experiments, graphical presentation of data.
Sensing- detecting level.Strain gages.Types and applications. Wheatston's bridge. Differential transformers. Capacitive transducers. Piesoelectric transducers.Hall-effect transducers.Capacitance pick-up. Relative velocity, translation and rotation measurements. Relative acceleration measurements.Force and torque measurements. Pressure measurements, different types. Measurement of fluid flow.Temperature measurements, some important notation. Digital techniques in mechanical measurements.Elements og digital electronics. Number systems. Multiplexers.Protocols. Digital computer as a measurement system tool.Microcomputers. Analog to digital conversion and v.v.Buses. Getting all together.

practical teaching

Some experiments, depending of student profile.

prerequisite

No specific conditions

learning resources

Electrical engineering laboratory

number of hours

lectures: 35

research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Measurement and Instrumentation in Engineering (Dekker Mechanical Engineering) By Francis S. Tse, Ivan E. Morse CRC Press.
Hand out

Measurement techniques in combustion

ID: PhD-3275
teaching professor: Stojiljković D. Dragoslava
ECTS credits: 5

goals

Introduction to modern techniques of measurement in the field of combustion.

learning outcomes

Mastering the modern techniques of measurement in the field of combustion.

theoretical teaching

Measurement of the volume and mass flow rate of liquid, gaseous and solid materials, methods and accuracy of each method. Temperature measuring methods and the accuracy of each method. Calculation of adiabatic combustion temperature based on the measured composition of the combustion products. Determination of combustion efficiency, temperature measurement and composition of the gaseous combustion products. Measurement of emission of harmful and dangerous substances from the combustion process, methods, principles and accuracy of each method.

practical teaching

Depending on defined topics of doctoral thesis the appropriate program of experimental work on the thesis is adopted.

prerequisite

Knowledge of the basics of measurements of fluid flow , temperature and weight measurements. Basic knowledge of thermodynamics and fluid mechanics.

learning resources

Instruments for the flue gas analysis.
Acquisition system for measurement of temperature, pressure, velocity, relative humidity.
Various sensors for temperature, velocity, relative humidity, pressure.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Stephen R. Turns, An Introduction to Combustion: Concepts and Applications, 2 edition, McGraw-Hill, 2000
E.L. Upp, Paul J. LaNasa, Fluid Flow Measurement A Practical Guide to Accurate Flow Measurement, Second Edition, Gulf Professional Publishing, 2002

Mechanics of Bipedal Gait

ID: PhD-3124
teaching professor: Lazarević P. Mihailo
ECTS credits: 5

goals

To introduce students to the application of fundamental principles and laws of biomechanics as well as human gait to understand and study human locomotor system (HLS) - prediction of functional motion / movement, human posture. The formation of the corresponding models of bipedal gait, 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) and human gait 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; understanding of the strategy of human gait ZMP (zero moment point), CMP (the centroidal moment pivot),analysis of selected motions of healthy people, patients and disabled people.

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 walking and running. 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.
Strategy of walking -ZMP (zero moment point), CMP (the centroidal moment pivot). Modern "gait" laboratory and basic measurements.Walking-inverted pendulum model, running-mass model and springs. Orthopedic biomechanics with emphasis on bipedal movement.

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 human gaint: various examples. 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. Various problems of HLS.
Clinical gait analysis -a case study

prerequisite

none

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]Christopher L V.,B.Davis, J.Connor, Dynamics of Human Gait, Kiboho Publishers ,South Africa,1999.
[6]Лазаревић М.Основе биомеханике,(скрипта у припреми),2011.
[7]Писани изводи са предавања(handouts),
[8] Cyberbotics Webots - софтверски пакет
[9]MATLAB,LegoMinstorm, софтверски пакети

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

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
Y. Hong and R. Bartlett,Routledge Handbook of Biomechanics and Human Movement Science,Routledge,2008.
S. Cowin, S. B.Doty,Tissue Mechanics, Springer Science+Business Media, LLC,2007

Mechanics of locomotor system

ID: PhD-3120
teaching professor: Lazarević P. Mihailo
ECTS credits: 5

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

none

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

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

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 of Nonholonomic Systems

ID: PhD-3077
teaching professor: Zeković N. Dragomir
ECTS credits: 5

goals

The goal of this course is to introduce students to the concepts, principles and methods in Mechanics of Nonholonomic Systems to enable practical problems using acquired knowledge of Mechanics of Nonholonomic Systems for monitoring and enable innovation in science and profession

learning outcomes

-to enable students to master terms, methods and principles in Mechanics of Nonholonomic Systems
-to enable students to relate the knowledge from Mechanics of Nonholonomic Systems with knowledge in other scientific fields, to apply knowledge from Mechanics of Nonholonomic Systems in analysis, synthesis and prediction of solutions and consequences of problems in science

theoretical teaching

Basic concepts: analytical definitions of constraints, possible displacements, similarity of variational and differential operations. Differential equations of motion of non-holonomic systems with linear non-holonomic constraints of first order: equations of motion forming by means of Lagrange-D'Alembert's principle, equations of motion in quasi-coordinates, determination of reactions of constraints. First integrals of equations of motion of non-holonomic systems: linear and quadratic integrals, integral of energy, generalized integrals of energy, cyclic integrals. Variational principles in mechanics of non-holonomic systems: Hamilton-Ostrogradsky's principle, Gauss' principle, Hertz's principle,. Stability of motion of non-holonomic systems: equilibrium, stability of steady motions. Non-holonomic systems having constraints of general kind: equations of motion having constraints of general kind. Technical problems of stability of systems with rolling: theory of motion of elastic pneumatic tire.

practical teaching

Basic concepts: analytical definitions of constraints, possible displacements, similarity of variational and differential operations. Differential equations of motion of non-holonomic systems with linear non-holonomic constraints of first order: equations of motion forming by means of Lagrange-D'Alembert's principle, equations of motion in quasi-coordinates, determination of reactions of constraints. First integrals of equations of motion of non-holonomic systems: linear and quadratic integrals, integral of energy, generalized integrals of energy, cyclic integrals. Variational principles in mechanics of non-holonomic systems: Hamilton-Ostrogradsky's principle, Gauss' principle, Hertz's principle,. Stability of motion of non-holonomic systems: equilibrium, stability of steady motions. Non-holonomic systems having constraints of general kind: equations of motion having constraints of general kind. Technical problems of stability of systems with rolling: theory of motion of elastic pneumatic tire.

prerequisite

Defined by the curriculum study of Phd studies program.

learning resources

Andjelic T., Stojanovic R.; Rational Mechanics, Belgrade, 1965.
Dobronravoff V.; Principles of Mechanics of Non-holonomic Systems, Nauka, Moscow, 1970.
Pars L.; Treatise on Analytical Dynamics, Nauka, Moscow, 1971.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

Andjelic T., Stojanovic R.; Rational Mechanics, Belgrade, 1965.
Dobronravoff V.; Principles of Mechanics of Non-holonomic Systems, Nauka, Moscow, 1970.
Pars L.; Treatise on Analytical Dynamics, Nauka, Moscow, 1971.

Mechanics of Variable Mass Systems

ID: PhD-3094
teaching professor: Jeremić M. Olivera
ECTS credits: 5

goals

-to provide students knowledge of the fundamental principles and methods in Dynamics of variable mass systems
-to enable students to solve practical problems in engineering using acquired knowledge in Dynamics of variable mass systems
-to prepare students to monitoring novelties in science and engineering

learning outcomes

-to enable students to master terms, methods and principles in Dynamics of variable mass systems
-to enable students to relate the knowledge from Dynamics of variable mass systems
with knowledge in other scientific fields, to apply knowledge from Dynamics of variable mass systems in analysis, synthesis and prediction of solutions and consequences of problems in science

theoretical teaching

Differential equation of motion of a particle having variable mass – Meshchersky's equation. Two Tsiolkovsky's problems. Motion of a particle having variable mass in a resisting medium. Inverse tasks of a particle having variable mass. Examples. Basic laws of dynamics of a body having variable mass. Differential equations of motion of a body having variable mass in Lagrangian (generalized) coordinates. Canonical form of equations of motion of a body having variable mass. Variational problems of a particle having variable mass.

practical teaching

Differential equation of motion of a particle having variable mass – Meshchersky's equation. Two Tsiolkovsky's problems. Motion of a particle having variable mass in a resisting medium. Inverse tasks of a particle having variable mass. Examples. Basic laws of dynamics of a body having variable mass. Differential equations of motion of a body having variable mass in Lagrangian (generalized) coordinates. Canonical form of equations of motion of a body having variable mass. Variational problems of a particle having variable mass.

prerequisite

Defined by the curriculum study of Phd studies program.

learning resources

Trivunac, J., Basic in Dynamics of Reactive Systems, Institut za prostornu tehniku, Beograd, 1968. 18.2. (handouts)

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

Komsodemjanskij A.; Course of Theoretical Mechanics, Part 2., Prosceshcheije, Moscow, 1966.
Gurin A.; Principles of Mechanics of bodies having variable mass and Dynamics of Rockets, Part 1., MGPI, Moscow, 1960.
Trivunac, J., Basic in Dynamics of Reactive Systems, Institut za prostornu tehniku, Beograd, 1968. 18.2

Mechanisms Synthesis

ID: PhD-3271
teaching professor: Stoimenov D. Miodrag
ECTS credits: 5

goals

Mastering the necessary knowledge in the field of mechanisms synthesis. Introduction to the mechanisms synthesis methods and their application to the appropriate application of technology that mechanism- machine should be done.

learning outcomes

By mastering the program acquire the following subject-specific skills: understanding the problems with the theory of mechanisms and machines, solving specific problems with the use of the scientific method and the use of appropriate software.

theoretical teaching

The development of the machines science. The fundamental concept of mechanisms. Kinematical modeling. Class a numeral and dimensional synthesis. Trajectory couplings and their use in machines. Synthesis in consecutive positions. Savaru-Euler equations. Cubic splines stationary curvature. Using a synthesis of infinitely close positions in engineering practice. Geometric methods for the synthesis of two-and three-point accurate. Fundamentals of the theory and Burmester accurate synthesis of four points. Algebraic methods of synthesis using complex numbers. Non-linear programming method and its application to the synthesis of mechanisms.

practical teaching

prerequisite

learning resources

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Mechatronics Systems and Adaptronics

ID: PhD-3208
teaching professor: Petrović B. Petar
ECTS credits: 5

goals

Higher theoretical background for design and practical realization of mechatronics systems, microelectromechanical and optronic systems; New approaches and concepts integration of sensory and control functions into mechanical structure of the system – knowledge on new materials, including multifunctional materials having embedded control and other functions which enables intelligent behavior. Higher theoretical foundations on selforganizing and cognitive systems an implementation of this knowledge on contemporary microprocessor platforms (microcontrollers, digital signal processors and FPGs).

learning outcomes

Theoretical knowledge and skills for solving various engineering problems in manufacturing engineering based on multidisiplinary approach, through simultaeously use of knowledge in the field of mechanics, electronics, software and new materials. Knowledge for building of intelligent sensory and actuation systems and their integration into production equipment – automatic and adaptive manufacturing systems, robotic systems an measuring systems.

theoretical teaching

Sensors and intelligent systems for signal conditioning, special chapters in optical sensory systems and optronics; Advanced techniques for signal digital processing; Actuation systems, special chapters on actuation systems based on new materials and actuation principles, embedded actuation systems with intelligent functions and behavior; Embedded systems with specialized functional modules and extensive networking functions; Integration of structure (material), actuation and sensory function; New multifunctional and smart materials (piezoceramics, shaped memory alloy, electro - and magnetorheological fluids, etc.); Microelectromechanical systems, including meso and partly nano level (nonlithographic manufacturing processes).

practical teaching

prerequisite

Mechatronics, Dynamics of machines and mechanical systems, Continuous and digital control systems, Cybernetics, Microcontrollers, Soft computing.

learning resources

number of hours

lectures: 35
research: 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

Bolton, W., Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Prentice Hall, 2004, ISBN-10: 0131216333.
H. Janocha, Adaptronics and Smart Structures: Basics, Materials, Design, and Applications, Springer, 1999, ISBN: 3540614842.
N. M. White, P. Boltryk, W. R. Habel, R. Petricevic, M. Gurka, Adaptronics and Smart Structures: Sensors in Adaptronics, Springer-Verlag, 2007, ISBN 978-3-540-71965-6.
V.N. Vapnik, The Nature of Statistical Learning Theory, Springer Verlag, 2 edition (November 19, 1999), ISBN-10: 0387987800.
B. Kosko, Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence, Prentice Hall; June 1991, ISBN-10: 0136114350.

Metallurgy of welded joints

ID: PhD-3219
teaching professor: Popović D. Olivera
ECTS credits: 5

goals

The aim of this course is to present the basic terms of welding metallurgy, as the most important field of science of welding, without whose understanding and knowledge is not possible to achieve a quality weld, and to establish a relationship of structure and properties of welded joints. For an understanding of this course, students need to have basic knowledge of materials science and physical metallurgy, which have gained in master classes. It is expected that upon completion of this course, students should be familiar with the metallurgical aspects of welding, including knowledge of microstructure and properties of welded joints, as well as the difficulties that arise in achieving high-quality joint, in order to be able to practically apply the knowledge and prescribe the proper technology welding.

learning outcomes

After fulfilling all the course requirements, a student is capable to solve concrete problems in the area of Metallurgy of welded joint, 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-Basic terms in fusion welding processes-The welding heat source and analysis of heat flow during welding-Chemical reactions in welding zone-Welding pool formation-Weld residual stresses-Basic concepts of solidification-Effect of cooling rate-Grain growth and phase transformation after solidification in the fusion zone-Macro and microsegregations in the fusion zone-The heat-affected zone-Recrystallization and grain growth of the heat-affected zone-Phase transformation during the welding of steel-Solidification cracking of welded joint-Precipitation-hardening materials (aluminium alloys and nickel-base alloys)-Welding of stainless steels.

practical teaching

Consultations

prerequisite

Completed master studies

learning resources

1. Sindo Kou, Welding Metallurgy, Second edition, John Wiley& Sons, (2003)
2. D.Seferijan, Metallurgy of welding, Грађевинска књига, (1969)
3. O.Grong, Metallurgical modelling of welding, Second edition, The Institute of materials, (1997)

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 100; requirements to take the exam (number of points): 0

references

Sindo Kou, Welding Metallurgy, Second edition, John Wiley& Sons, (2003)
J.F.Lancaster, Metallurgy of welding, Sixth edition, Abington publishing, (1999)
O.Grong, Metallurgical modelling of welding, Second edition, The Institute of materials, (1997)
W.Galvery, F.Marlow, Welding essentials: Questions&Answers, Second edition, Industrial Press Inc., (2007)

Methods in the design and construction of process equipment

ID: PhD-3203
teaching professor: Petrović LJ. Aleksandar
ECTS credits: 5

goals

Students master the material relating to the stress state in the construction of equipment for pressure testing and qualification of errors and different approaches to construction of pressure equipment and construction of non standard parts and not the usual load of pressure vessels.

learning outcomes

By mastering the program, students acquire the following skills: analysis, synthesis and forecasting solutions and consequences, the development of critical and self-critical thinking and approach, application of knowledge in practice; overcome substance that is related to stress states in the construction of equipment for pressure testing and qualification errors.

theoretical teaching

Theoretical aspects of the class and division apparatus. Calculation methods appliances from the standpoint of strength. The principal hypothesis of the fracture from the theory of elasticity. The choice of materials with respect to speficičnosti conditions. Finite element methods and other numerical methods for modeling. Occurrence of mechanical stress in machining. Appearance of the mechanical stress treatment without cutting. Classification and calculation of stresses in welded joints. Elastic and plastic deformation. The theory of flow. Complex stress states. Introduction to Fracture Mechanics. The formation and development of cracks.

practical teaching

Student prepares research paper. Instruction and preparation for the seminar work carried out through the analysis of different types of activities. It includes the results of tests and measurement analysis of issues that needs to be solved, obtaining literature and its analysis.

prerequisite

Attendance requirement is defined by the interest of candidates and dissertation topic

learning resources

Subject to available resources are used at the university, which include Classroom space, laboratory facilities and library. Literature is meant the subject teacher in the office and the library faculty.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 0; calculation tasks: 0; seminar works: 45; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

Grebenuk, K.M., Mihevoi, NS, Rasčeti and tasks per process and apparatus writer's output, Agroproiizdat, Moscow, 1987.
Sokolov, V.I., Fundamentals and rasčeta konstruirovanija mašinja and aparatov , Mašinostroenine, Moscow, 1983
Fatique of Welded Structures, British Welding Research Association Spries, Cambridge University Press, London

Methods of design, construction, calculation and optimization of the process, plant, equipment and machinery

ID: PhD-3291
teaching professor: Topić M. Radivoje
ECTS credits: 5

goals

The study of new and specific techniques and technologies of the drying process, calculation and the optimization.

learning outcomes

Training to solve issues related to the use of new technologies and special drying process and optimization.

theoretical teaching

Fundamental aspects (Drying of Solids, Principles, Calculation and Selection of Dryers. Description of Various Dryer Types. Drying in Various Industrial Sectors.

practical teaching

Laboratory work related to the modeling of drying of materials in pneumatic rotary dryers

prerequisite

Regulated by the program of study

learning resources

Laboratory installations are located in the Institute. Books in the cabinet 532nd

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Arun S. Mujumdar; Handbook of Industrial Drying, Marcel Dekker, 270 Madison Avenue, New York.
Drying Technology an Intenational Journal, Marcel Dekker, 270 Madison Avenue, New York
Mathematical Modeling and Numerical Techniques in Drying Technology, Marcel Dekker, 270 Madison Avenue, New York.

Methods of Optimization Mechanical Systems

ID: PhD-3243
teaching professor: Rosić B. Božidar
ECTS credits: 5

goals

The main goal of this course for the student is to give the necessary knowledge of:
• numerical analysis and optimization,
• understanding general principles of design optimization
• formulating the optimization problems and identify critical elements.

learning outcomes

During this course, the student will carry out:

• Overview of design optimization
• Fundamentals of engineering optimization
• Problem formulation
• strategies for optimization

theoretical teaching

1.Introduction to Modeling and Optimum Design Process. Optimum design problem formulation.
A general mathematical model for optimization.
2.Graphical Optimization.Identification of feasible region. Use of MATLAB for graphical optimization.
3. Unconstrained Optimum Design Problems. Optimality conditions for functions of several variables.
4.Engineering design examples with MATLAB.
5. Nonlinear Programming. Problem formulation. Equality constrained problem. Inequality constrained optimization.
Basic ideas and algorithms for step size determination.
6. Numerical methods - The One-dimensional Problem. Optimum design examples with MATLAB.
7. Numerical Methods for Unconstrained Optimization.
Numerical Methods - Nongradient methods.
Powell's method.
Numerical Methods-Gradient-Based Methods.
Conjugate Gradient (Fletcher-Reeves) Method.
Davidon-Fletcher- Powel (DFP) method.
8. Numerical Methods for Constrained optimization
Problem definition. Necessary conditions. Method of feasible directions.Gradient projection method.
Exterior penalty function method.
9. Introduction to the Formulation of the Multicriterion Optimization Problem. Decision variables. Constraints. Objective functions.Space of Decision Variables and Space of Objective Functions. Pareto Optimum. Min-Max optimum.
10. Decision Making Problem.
Weighting Objectives Method.
Goal Programming Method.
Interactive Multicriterion optimization method.
11.Genetic Algorithm with MATLAB for optimum design examples.

practical teaching

Consists of the auditory and laboratory exercises.
Projects are main component of this course.

prerequisite

Knowledge of linear algebra and numerical mathematics. Computer programming in MATLAB.
Some knowledge of basic machine elements and mechanics.

learning resources

Computer Usage:
Students extensively use the computer and optimization toolbox using MATLAB program.
Handout and books.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Jasbir S. Arora: " Introduction to Optimum Design", Elsevier Academic Press
P. Venkataraman: " Applied Optimization with Matlab Programming", John Wiley and sons, inc.
H. Eschenauer, J. Koski, A. Osyczka: "Multicriteria Design Optimization", Springer-Verlag
Randy L. Haupr, Sue Ellen Haupt: :"Practical Genetic Algorithms", John Wiley and sons, inc.

Microchannel fluid flow

ID: PhD-3267
teaching professor: Stevanović D. Nevena
ECTS credits: 5

goals

The aim of this subject is getting knowledge about specific phenomena which occur in the fluid flow in micro systems as well as about scientific and mathematical methods that allow obtaining analytical and numerical solutions for prediction, analysis and research gas and liquid flow in channels whose characteristic dimensions are of the order of micrometers.

learning outcomes

Students are qualifying for computing pressure, velocity and temperature field in micro structure fluid flow and analyzing the effects of different flow conditions and boundary conditions on them with contemporary scientific and mathematical methods. Also, they qualify to recognize specific phenomena which appears in microdevices fluid flow due to the large surface to volume ratios and to coupling of flow with heat and mass transport as well as electromagnetic fields.

theoretical teaching

Theoretical lessons incorporates applications of the fundamental laws (mass, momentum, and energy) that govern fluid mechanics in order to solve and model gas and liquid flow in the microchannels, application of the boundary conditions characteristic for the gas flow in the microsistems i.e. slip, thermal creeping and temperature jump at the boundary, introducing with electrokinetic’s phenomena which occur in liquid microchannel flow and mathematical modelling surface tension driven flows i.e. electrophoresis and electro-osmotic flow.

practical teaching

Practical lessons contains: application of the basic fluid mechanics equations for the solving analytical and numerical solutions for the modeling fluid flow in the micro structures which include different effects as rarefaction, slip, thermal creeping, temperature jump at the wall, electro-hydrodynamic phenomena as the electric double layer and creating and solving mathematical models for electro kinetic and electroosmotic flows.

prerequisite

Passed exam in Fluid mechanic.

learning resources

Course handouts.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

Karniadakis G., Beskok A., Aluru N., Microflows and Nanoflows Fundamental and Simulations, Springer, 2005
Bruus H., Theoretical Microfluidics, Oxford University Press, 2008.
Kirby, B., Micro and Nanoscale Transport in Microfluid Devices, Cambridge University Press, 2010.
Dongqing L., Encyclopedia of Microfluidics and Nanofluidics, Springer, 2008.
Stevanović,N.,Fluid flows in microdevices, Faculty of Mechanical Engineering, Belgrede,2010.

Modelling of Composite Material Micromechanics

ID: PhD-3399
teaching professor: Balać M. Igor
ECTS credits: 5

goals

Learn the fundamental principles of the modeling of non isotropic materials. Apply these principles to proper modeling multi-directional fiber composite as well as particulate composite materials based on properties of composite constituents. Examine basic issues associated with the design of these composite materials for various applications. Learn methods of computer modeling of composite structures in FEM based software.

learning outcomes

1. Students can determine the elastic constants and strength of different types of composites, for given constituent properties, volume fraction and distribution of reinforcement.
2. Students are capable to make different types of micromechanical models of porous (optional) and non porous composites based on properties of composite constituents.
3. Students can, using FEM, numerically model different types of composites for various applications based on individual properties of the reinforcement and the matrix.
4. Students have developed a basic understanding of load transfer between matrix and reinforcement.

theoretical teaching

1. Introduction to micromechanics of composite materials - Volume and mass fractions, distribution of reinforcement, density and void content.
2. Evaluation of composite elastic moduli: Representative volume element (RVE) - elementary mechanics of material models.
3. Numerical models for various distribution of reinforcement – 2D and 3D (SC distribution and FCC distribution), Semi-empirical models.
4. Various micromechanics models for elastic moduli: Longitudinal Young modulus. Transverse Young modulus. In plane shear modulus. Poissons ratio.
5. Micromechanics models for lamina strength: Strength of unidirectional composites. Longitudinal strength, fiber and matrix failure mode. Transverse strength. In plane shear strength.
6. Analysis of particulate reinforced composites: Influence of volume fraction, distribution and shape of particles on elastic constants and strength. Porous and nonporous matrix.

practical teaching

1.

prerequisite

Taken exams:
Strength of materials
The base of strenght of constructions
Basics of composite materials mechanics

learning resources

The whole course material is well covered by hand-outs written by the lecturers of the course.

Every attendee of the course will be provided his/hers own copy of the hand-outs. Apart of this, all the below mentioned books can be borrowed from the lecturers during the course or ordered on some relevant websites. Moreover, significant number of scientific papers covering listed topics are available.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 40; laboratory exercises: 0; calculation tasks: 5; seminar works: 20; project design: 0; final exam: 30; requirements to take the exam (number of points): 0

references

"Mechanics of composite materials", Autar K. Kaw
"Mechanics and analysis of composite materials", Valery Vasiliev and Evgeny Morozov
"Mechanics of composite materials", Robert M. Jones
"Principles of composite materials mechanics", Ronald F. Gibson

Modelling of Refrigeration Systems

ID: PhD-3386
teaching professor: Kosi F. Franc
ECTS credits: 5

goals

Achieving competency in individual and team research work in the field of modeling and optimization of refrigeration technology. Development of creative skills of analysis and synthesis of complex technical refrigeration systems in accordance with established basic tasks and goals of the study program.

learning outcomes

PhD student acquires specific skills to self-observe, formulate and solve relevant problems by using modern methods of testing and analysis of complex technical systems; as part of a team, organizes and performs the necessary analysis and calculations and proposes appropriate solutions.

theoretical teaching

Analysis and prediction of complete vapour compression refrigeration system performances (estimation of „working state“ of the system)
Reciprocating compressor performance characteristics: single stage and two-stage compressor, performance characteristics calculation
Simultaneous heat and mass transfer between water-wetted surfaces and air, the straight line law, adiabatic saturation and thermodynamic wet bulb temperature, thermodynamic analisys of important psychrometric processes
Condenser performance characteristics: condensing heat transfer, refrigerant condensation on inside surface of horizontal tubes, noncondensable gases, air-cooled condensers, evaporative condensers, performance characteristics calculation
Evaporator performance characteristics: classifying the evaporators, natural convection type evaporator coils, flooded evaporators, latent cool storage evaporators (with ice accumulation), thermal design of evaporators (estimation of heat transfer coefficients: air side heat transfer coefficients in fin-and-tube type evaporators, boiling heat transfer coefficients on coils, forced convection boiling inside tubes, enhancement of heat transfer coefficients, heat transfer surface calculation), performance characteristics calculation
Throtting valve characteristics
Performance of condensing unit (compressor and condenser) as a function of evaporator and condensing temperatures)
Performance of complete system - condensing unit and evaporator
Heat pumps - performance of complete system

practical teaching

prerequisite

no specific conditions, useful basic knowledge in thermodynamics.

learning resources

number of hours

lectures: 35

research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Markoski M.: Refrigeration devices, Facultu of Mechanical Engineering, Belgrade, 2006
ASHRAE Handbook, 2009, Fundamentals, American Society of Heating, Refrigeration and Air-Conditioning, Engineers, inc., Tullie Circle, n,e., Atlanta, GA 30329.
ASHRAE Handbook, Refrigeration, 2010, American Society of Heating, Refrigeration and Air-Conditioning, Engineers, inc., Tullie Circle, n,e., Atlanta, GA 30329.
Jungnickel, H., Agsten, R., Kraus W. E.: “Grundlagen der Kältetechnik”, VEB Verlag Technik, Berlin, 1980.
EE IIT, Kharagpur, India: Refrigeration and Air Conditioning, 2008

Modelling of thermalhydraulic transients

ID: PhD-3264
teaching professor: Stevanović D. Vladimir
ECTS credits: 5

goals

The aim of the subject is developing skills for the simulation and analyses of thermalhydraulic transients in complex pipeline networks and components of energy plants.

learning outcomes

Students are trained to develop mathematical models of thermalhydraulic transients, to solve these models with analytical and numerical methods and to conduct simulation and analyses with the aim of safety evaluations of energy plants, as a support to the design of control and safety systems and to the defining of operational procedures.

theoretical teaching

Developing of the lumped parameters models of two-phase gas-liquid systems with phase transitions, one-dimensional compressible flows of one-phase and two-phase fluids, and multidimensional conduction and one-phase and two-phase flows in multidimensional space. Numerical methods for the solving of the system of ordinary differential equations, the method of characteristics for the solving of the system of hyperbolic partial differential equations, and control volume methods for the solving of parabolic and elliptic partial differential equations.

practical teaching

Computer simulations of dynamical pressure changes in steam accumulators and pressurizers applied in the district heating systems and nuclear steam supply systems. Computer simulations of gas pipeline, district heating system and steam generator transients.

prerequisite

Attended courses in Fluid Mechanics, Thermodynamics and Numerical methods within maser or doctoral studies.

learning resources

Course handouts.
Stevanović, V., Thermal-Hydraulics of Steam Generators – Modelling and Numerical Simulation, Monograph, Faculty of Mechanical Engineering, Belgrade, 2006.
Computer equipment.
Software for numerical solving of systems of differential equations of various types.
Software for simulation and analyses of pressure transients in pipeline networks and pressurized vessels.
Software for simulation and analyses of multidimensional two-phase flows.

number of hours

lectures: 35
research: 0

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): 50

references

Versteeg, H.K., Malalasekera, W., An introduction to Computational Fluid Dynamics, Longman Group Ltd., Harlow, 1995.
Wulff, W., Computational methods for multiphase flow, Multiphase Science and Technology, Vol. 5, Begell House, 1990.
Streeter, V.L., Wylie, E.B., Hydraulic Transients, McGraw Hill, New York, 1967.
C., Anderson, D.A., Pletcher, R.H., Computational Fluid Mechanics and Heat Transfer, Taylor&Francis, New York, 1997.
Stevanovic, V., Thermal-Hydraulics of Steam Generators – Modelling and Numerical Simulation, University of Belgrade, Faculty of Mechanical Engineering, 2006.

Modelling, optimisation and forecasting in Industrial engineering

ID: PhD-3022
teaching professor: Bugarić S. Uglješa
ECTS credits: 5

goals

Achieving competency and enhancement of gained knowledge in academic studies in fields of modelling, optimisation and forecasting for needs and implementation in Industrial engineering, as well as development of creative skills and overwhelm with practical skills needed for professional practice in solving real world problems of Industrial engineering.

learning outcomes

Curriculum overcome enables coverage of overall skills as analysis and synthesis of real world problems in industry using mathematic tools underlying: modelling (mathematical modelling of real world system), optimisation (gaining optimal configuration of real world system) and forecasting (work of real system in future).

theoretical teaching

Modelling – What is mathematical modelling ? (or how to translate our beliefs about how the world functions into the language of mathematics). Division of mathematical models (deterministic, stochastic). Range of objectives obtained using mathematical modelling (developing scientific understanding, test the effect of changes in a system, aid to decision making).
Optimisation – Optimisation as an mathematical discipline. Finding of minimal and maximal values of goal functions subject to constrains. Overview of optimisation methods.
Forecasting – Time series, Forecasting methods, Forecasting errors, Regression analysis (linear regression, method of least squares), Forecasting in practice.

practical teaching

Selection of real world industrial system connected with candidate research, which should be used as a basis for system modelling, optimisation and forecasting.

prerequisite

Students should have (but not necessary) a background in statistics, system engineering, mathematics, computer science.

learning resources

1. Bugaric, U., Petrovic, D.: Servicing system modelling, Faculty of Mechanical engineering Belgrade, Belgrade, 2011.
2. Bugaric, U.: Methodology for analysis of single position machines work, Foundation Andrejevic, Belgrade, 2003.
3. Software: QtsPlus 3.0 (Queuing theory software Plus).
4. Software: QSopt Version 1.0 (Linear programming problems).
5. Software: IOR Tutorial (Interactive Operations Research).
6. Software: MS – Project (Project management).
7. Personal computers.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 100; requirements to take the exam (number of points): 0

references

Petrić, J.: Operations Research (book 1 & 2), Savremena administracija, Belgrade, 1990.
Churchman, C. W., Ackoff, R. L., Arnoff, E. L.: Introduction to Operations research, John Willey & Sons Inc., 1957.
Hillier, F. S., Lieberman, G. J.: Introduction to operations research (seventh edition), McGraw-Hill, New York, 2000.

Modern biomedical and dental devices

ID: PhD-3058
teaching professor: Sedmak S. Aleksandar
ECTS credits: 5

goals

Introducing students to the application of different biomaterials and devices in order to understand and study their functional behaviour in contact with the human body. Analysis of the connections between the biomaterial and the body system, in order to ensure reliable implant operation. Review of the procedures and methods used in biomedical engineering for development and examination of implants. Review of modern medical and dental devices and its possibilities of application. Application of standards in biomedical engineering. Sterilization Methods for devices and implants in medicine and dentistry.The potential co-operation with experts in the field of materials science and medicine is allowed, which provides the ability to work in specialized laboratories and clinical facilities.

learning outcomes

By attending this course the student will master the application of biomaterials and devices in medicine and dentistry, using modern scientific methods. Students gain insight into the standards for the testing and development of biomaterials and implants, and standards for the development and application of medical and dental devices. Theoretical considerations, laboratory experimental work and the application of numerical analysis using the licensed software for finite element method, enables the synergy of the previously acquired knowledge in physics, materials science, mathematics and mechanics, in order to implement them in engineering practice.

theoretical teaching

Application of biomaterials in medicine and dentistry. Fundamentals of making implants in the human body. Compounding biomaterials and achieving biocompatibility. Problems of contact surfaces in designing the structure of biomaterials in the human body. The problems of various physical, chemical and mechanical properties of combined materials. Damage of biomaterials during the exploitation: wear, corrosion and fatigue of biomaterials, corrosion under stress, cracking. Biocomposite materials; achieving a gradual change in material properties in the compound (functionally graded materials FGM). Thin coatings and nanostructured biomaterials. New alloys in biomedical applications. Testing of biomaterials. Lifetime and structural integrity assurance of biomaterials: analytical, numerical and experimental methods. Prevention of failure of the biomaterials structure (case studies). Standards for testing and manufacturing of biomaterials. Standards for testing and manufacturing of implants. Review of modern devices used in medicine. Sterilization methods. Review of devices used in dentistry. Manufacturing of modern dental and medical devices. Standards for testing devices that are used in biomedical applications.

practical teaching

Examples of applications of biomaterials in the design, development and exploitation of structures used in medicine and dentistry. Examples and solutions of implants that are made from biomaterials, known from the Biomaterials 1 course. Experimental Methods In Vitro and In Vivo. Application of analytical and numerical models in the structural integrity assurance of biomaterials. Development of a model using the finite element method. Calculation examples considering problems in designing connecting surfaces in biomaterial structures. Application of configuration forces method to prevent failure of the biomaterials structures.Examples of devices application in medicine. Examples of devices application in dentistry.

prerequisite

learning resources

[1] Written lessons from lectures (handouts)
[2] Excerpts from the standard
[3] A. Sedmak, Use of the fracture mechanics on the structure integrity assessment, Faculty of Mechanical Engineering, Belgrade, 2003.
[4] J.B. Park and R.S. Lakes, Biomaterials An Introduction, Plenum Press, New York, 1992.
[5] Milne, I., Ritchie, R.O., Karihaloo, B., Comprehensive Structural Integrity, Vol. 9: Bioengineering. Elsevier Ltd, Oxford, 2003.

number of hours

lectures: 35
research: 0

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): 40

references

J.B. Park and R.S. Lakes. Biomaterials An Introduction. Plenum Press, New York, 1992.
I.Milne, R.O. Ritcie, B. Karihaloo. Comprehensive Structural Integrity, Vol. 9: Bioengineering. Elsevier Ltd, Oxford, 2003.
D. M. Brunette, P. Tengvall, M. Textor, P. Thomsen, Titanium in Medicine, Springer, Berlin, 2001.
Bronyino,J.D. Medical Devices and Systems, CRC Press, Boca Raton, 2006.

Modern Concepts of Organization

ID: PhD-3358
teaching professor: Misita Ž. Mirjana
ECTS credits: 5

goals

This course covers the principles and practice of modern management in the contemporary industrial with a great deal of details. Aim is to provide PhD students an understanding of the roles which knowledge of modern management techniques and tools plays in organizations, irrespective of their scope or size, orientation, purpose and even sector in which they operate.

learning outcomes

Enables the students to compare and contrast different approaches to the study of organizations. Students will be able to analyze organizations: organizations as rational, natural, and open systems; environments, strategies, and structures of organizations; and organizations and society.There is no single approach that is adequate to deal with the real-world variety of organizations.
By the application wide range of modern organizational-diagnostic techniques and other management tools, students can determine adequate concept for management of certain organization.

theoretical teaching

1. The modern theory of organization 2. The contingency theory of organization 3. Khandwalla's model of functioning of organization 4. Mintzberg's organizational configurations 5. Burton and Obel's contingency model. Use of OrgCon software package in diagnosis of organization 6. Donaldson's non-contingency theory 7. Types of organizational structures in modern theory of organization 8. Organizational change. Diagnosis and management of organizational change. A case-study example of analyzing the state of organization in a specific company 9. The possibility of implementation of modern concepts of organization in companies 10. Open issues and directions of further development of modern concepts of organizations

practical teaching

A case-study from the field of diagnosis of the state of organization in a company and application of modern concepts of organization.

prerequisite

Enrolled 2nd semester of doctoral studies.

learning resources

On-line free academic access to electronic databases: ebesco, science-direct, emerald, etc. Computer classroom. Real practical example in pilot factory - access to real data and database in for purpose of solving real organizational complex problems.

number of hours

lectures: 35
research: 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: 80; final exam: 10; requirements to take the exam (number of points): 30

references

Omolaja, M.A., Radovic-Markovic, M., 2008, Modern Management: Concepts and Topical Issues, Aardvark Global Salt Lake City UT, US.
Clegg, S.R,1990. Modern Organizations: Organization Studies in the Postmodern World, Sage Publications, pp.272.
Scott, W.R., Davis, G.F, 2007, Organizations and organizing: rational, natural, and open systems perspectives, Pearson Prentice Hall, pp. 452.
Wit, B.D., Meyer, R., 2010, Strategy: Process, Content, Context, Cemgage Learning EMEA, pp. 975.
Burton, R., Obel, B., Fit and Misfits in the Multi-Dimensional Contigency Model: An Organizatiional Change Perspective, LOK Center, Danish Social Science Research Council, 2000.

Modern concepts of organizations

ID: PhD-3152
teaching professor: Milanović D. Dragan
ECTS credits: 5

goals

Researching and studying the state of the company and applying modern concepts of organization.

learning outcomes

Acquisition of skills necessary for independent use of methods and techniques for studying and analyzing the state of organizations and the skills vital for applying modern concepts of organizations.

theoretical teaching

1. The modern theory of organization 2. The contingency theory of organization 3. Khandwalla's model of functioning of organization 4. Mintzberg's organizational configurations 5. Burton and Obel's contingency model. Use of OrgCon software package in diagnosis of organization 6. Donaldson's non-contingency theory 7. Types of organizational structures in modern theory of organization 8. Organizational change. Diagnosis and management of organizational change. A case-study example of analyzing the state of organization in a specific company 9. The possibility of implementation of modern concepts of organization in companies 10. Open issues and directions of further development of modern concepts of organizations

practical teaching

A case-study from the field of diagnosis of the state of organization in a company and application of modern concepts of organization.

prerequisite

Students should be enrolled in the second year of doctoral studies.

learning resources

number of hours

lectures: 35
research: 0

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): 30

references

Mintzberg, H., Structure in Five - Designing Effective Organizations, Prentice Hall, Englewood Clifs, New York, 1983.
Mintzberg, H., The Structuring of Organizations, Prentice Hall Englewood Cliffs, New York, 1979.
Moore, B., Brown, A, The Application of TQM: organic or mechanistic, International Journal of Quality and Reliability, Vol. 23, No. 7, pp. 721-742, 2006.
Khandwalla, N.P. The Design of Organization, Harcourt Brace Jovanovic, New York, 1977.
Burton, R., Obel, B., Fit and Misfits in the Multi-Dimensional Contigency Model: An Organizatiional Change Perspective, LOK Center, Danish Social Science Research Council, 2000.

Motion control of mechanical systems

ID: PhD-3197
teaching professor: Obradović M. Aleksandar
ECTS credits: 5

goals

To introduce students to the mathematical theory of optimal control and allow students to solve problems of optimal control of mechanical systems.

learning outcomes

The student is able to formulate the problem of optimal control of mechanical systems with finite number of degrees of freedom and to resolve it, including numerical solution of systems whose movement is described by nonlinear differential equations of motion.

theoretical teaching

Classic extremal problems in mechanics. Control in mechanical systems. The goal of motion control. Objective function. Optimal control. The differential equations of controlled mechanical system. Maximum principle. Transversality conditions. Limited control. Mechanical systems wuth limited phase state. Singular control. Examples of singular control. Parameter optimization. Motion control of rigid bodies. Examples of optimal control of rigid body systems motion. Optimal stabilization of motion of the mechanical system. Bellman optimality principle and the method of Lyapunov functions. Asymptotic stabilization of movement.

practical teaching

prerequisite

None

learning resources

Pontryagin L S, Boltyanskii V G, Gamkrelidze R V, Mishchenko E F (1983) Mathematical Theory of Optimal Processes (in Russian). Nauka, Moscow.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

Vujanović B.D. and Spasić D.T. (2009): Part II: Fundamentals of Optimal Control Theory", Novi Sad University Press, Novi Sad,
Leitmann, G., An Introduction to Optimal Control, McGraw-Hill , New York,1966.
Sage P, White C (1977) Optimum Systems Control. Prentice-Hall, Englewood
Gabasov R. and Kirillova F.M. Singular Optimal Controls. – Moscow, Nauka, 1973 (in Russian)

Motor Vehicles Braking

ID: PhD-3003
teaching professor: Aleksendrić S. Dragan
ECTS credits: 5

goals

Research and development in the area of braking systems of motor vehicles and trailers.

learning outcomes

Development of students' abilities for conducting scientific research in the area of advanced braking systems of motor vehilces and trailers.

theoretical teaching

Teoretical lectures are based on consultation with students in accordance with the previously issued seminar works related to the braking of motor vehicles and trailers.

practical teaching

Practical lectures will be coordinated with the students research tasks related to the braking of motor vehicles and trailers.

prerequisite

There is no precondition.

learning resources

Todorović J. Kočenje motornih vozila, Mašinski fakultet Beograd, 1996.
Aleksendrić D., Ćirović V. Inteligentno kočenje,(knjiga u pripremi), 2012.
Miljković Z., Aleksendrić D. Veštačke neuronske mreže - zbirka rešenih zadataka sa izvodima iz teorije, Mašinski fakultet Beograd, 2009.
Savaresi S., Taneli M. Active Braking Control Systems Design for Vehicles, Springer 2010.
Pacejka H.B. Tyre and vehicle dynamics, Butterworth-Heinemann, 2002.

number of hours

lectures: 35
research: 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

Nano systems

ID: PhD-3110
teaching professor: Koruga LJ. Đuro
ECTS credits: 5

goals

To introduce students to contemporary approaches to systems theory and it's application to nano-level. To enable a systematic approach to designing systems at the nano-level in terms of mass, energy, information, organization and management.

learning outcomes

A student is qualified for systematic/synergistic approach to discussing the relations between parts and wholes in nano-level. Understanding the physico-chemical basis of the nanosystems nanomechanics, nanoelectronics, nanophotonics, fluid and heat transport on the nano-level and nanobiotechnology.

theoretical teaching

Nanomechanics, Nanothermodinamics, nanomaterials and nanoelectronics. Information theory and its applications in coding. Space-time coding systems to nano-level. Biological systems as mimicry nanosystems. Codogen self-asembling and self-organizing molecular and nano-systems.

practical teaching

Fractal analysis of the human organism as the initial nano-systems. Modeling embryogenesis synergies in terms of mass, energy, information, organization and management. "Light-RGB" model of human embryogenesis. Biomimicry "Light-RGB" model of man to the technical nano-system.

prerequisite

Enrolled doctoral studies.

learning resources

1. Computer workstation "Light-RGB"

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Rogeres,B., Nanotechnology: Understending Small Systems, CRC Press, Boca Raton, 2008.
Koruga, Dj. et al. Fullerene C60: Hystory, Physics, Nanobiology, Nanotechnology, Elsevier, Amsterdam, 1993

Nanotechnology in medicine and stomatology

ID: PhD-3322
teaching professor: Matija R. Lidija
ECTS credits: 5

goals

The main objective of the proposed course is that students master the knowledge in the field of science and technology at the nano level. They will be trained to characterize biomolecules, biomaterials and nanomaterials that are used in medicine and dentistry by STM / AFM / MFM. The doctoral students will be able to do experiments by NanoProb device in order to complete their doctoral work.

learning outcomes

The student will be trained to prepare a sample, to choose a method for the characterization of nano samples, to explore the characteristics of the sample, using NanoProb device, as well as to process obtained and write a report.

theoretical teaching

Physically oriented nanotechnology and their application in medicine and dentistry. Chemically oriented nanotechnology and their application in medicine and dentistry. The principle of operation of NanoProb devices, modules STM / AFM / MFM. A sample preparation. The NanoProbe device procedure. The recorded results saving and the processing of results.

practical teaching

A sample preparation: solid, powder and biological samples. The sample surface selecting. The determination of the STM probe and cantilevers for AFM / MFM. A Practical work on Nanoprobe device: module STM, AFM module, the module MFM. The Analysis and interpretation of results.

prerequisite

To be enrolled in doctoral studies.

learning resources

1. A Nanoprobe device (JEOL, Japan)
2. A CVD (a device for making surface-based thin-film)
3. Devices for making tablets of powder material
4. A fluid cells for electrochemical research within the NanoProb device

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Hornyak,G.L., ntroduction to nanaoscience and nanaoatechnology, CRC Press, Boca Raton, 2009
Vo-Dinh,T., Ed. Nanotechnology in biology and medicine, CRC Press, Boca Raton, 2007
Kumar, C., Ed. Nanofabrication: Towards Biomedical Application, Wiley-VCH, Freiburg, 2005
Shatkin, J.A., nanotechnology: health and Environmental Risk, CRC Press,Boca Raton, 2008

Non-Destructive-Testing

ID: PhD-3360
teaching professor: Sedmak S. Aleksandar
ECTS credits: 5

goals

Understanding the basic principles of non-destructive evaluation (Nondestructive Evaluation - NDE), which includes many terms used to describe a variety of activities, some of these terms are non-destructive testing (Nondestructive Testing - NDT), non-destructive inspection (Nondestructive inspection - NDI), and controls without destruction (Nondestructive examination, marked - NDEx). These activities include examination, inspection and control, for which is common to primarily determine some characteristics of a structure or to determine if in the structure does exist irregularities, discontinuities or cracks. Introducing students to the terms of anomaly (imperfections), discontinuity and error which may be used to explain that something regards to the part or the structure is questionable. Understanding and solving exercises in Non-Destructive-Testing. Development of an independent paper by creation and presentation of selected seminar papers.

learning outcomes

By attending the course the students are mastering the basic knowledge of all activities from NDT, NDI and NDEx used to find, locate, measure and determine something about the structure or the error on the structure. Theoretical considerations and practical examples enable the student to master all the necessary principles to decide whether the structure or errors are acceptable or not. Students are enable to define when is important to select NDE procedures, and to define which types of errors are unacceptable, to specify size and orientation of unacceptable errors, and to determine locations of the error that may cause structure unacceptability. Introducing students to techniques of NDE methods selection, current modern standards and recommendations in this field.

theoretical teaching

General introduction to welding and joining technology. Welding processes. Manufacture and designation of steels. Introduction to metallurgy of steelmaking. Defects in steels. Structure and properties of pure metals. Crystal structure types. Micro structures of metals. Solid state transformation. Alloys and phase diagrams. Basic types of phase diagrams(non-,fully- and partly mixable components).Crystal segregation. Time-temperature-transformation (TTT) diagrams. Heat treatments of base materials and welded joints. Structure of the welded joint. Heat-affected zone (HAZ).Microstructure of the HAZ.Grain growth. Factors influencing cracking. Cracking phenomena in steels. Testing materials and the weld joint. Review of destructive testing. Technological specimens. Special tests. Metallographic examinations. Specimen preparation. Concept of quality assurance and quality control. Quality control during manufacture. Measurement, control and recording in welding.Non-destructive testing. Types of weld defects (IIW-designation). Acceptance criteria (e.g. ISO/DIS 5817.3 and 10042).Fundamentals of NDT methods (visual, dye penetrant, magnetic particle, eddy current, acoustic emission, radiography, ultrasonics, etc.).Field of application and limitations. Design in respect to NDT.Calibration.Interpretation (IIW Radiographic reference).Recording of data. Qualification of NDT personnel.NDT procedures. Use of standards and specifications. Health and safety aspects.

practical teaching

Regulations. Structure of the weld. Microstructure of the HAZ.Tests for determining the cold-crack-sensitivity. Standards on low temperature steels and consumables. Welding problems and precautions. Metallographic examinations. Specimen preparation. Macro and micro examination.Non-destructive testing-laboratory exercises.NDE methods selection. Primary factors associated with the choice of NDE methods. The reasons for the application of NDE.Types of cracks significant in structures. The size and orientation of the crack that is unacceptable.Predicted crack locations significant to the structure. The size and shape of the structure. The material features to be evaluated.

prerequisite

learning resources

number of hours

lectures: 35
research: 0

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): 40

references

R.W.Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, New York, 1996.

Nonlinear Digital Control Systems

ID: PhD-3025
teaching professor: Bučevac M. Zoran
ECTS credits: 5

goals

Mastering with: techniques for analysis and synthesis of nonlinear digital control systems

learning outcomes

Knowledge of the techniques for analysis and synthesis of nonlinear digital control systems.

theoretical teaching

Practical Aspects of the system with different types of modulation, and quantization due to the level. Mathematical modeling of frequency and width modulated systems, and systems quantized due to the level. Transient processes. Dynamic properties. Methods of analysis and design (Lyapunov method).

practical teaching

• Direct tracking of the course theory through the illustrative examples,
• Define and elaborate of the task of seminar paper,
• Consultation.

prerequisite

There are no requirements.

learning resources

• Manuscript at http://au.mas.bg.ac.rs/Nastava-Kau/Nastava_Download.htm
• Видаль П., Нелинейные импульсные системы, Перевод с французского Б. Ю. Мандровского-Соколова, Под ред. В. М. Кунцевича, Энергия, Москва, 1974.
• Digital computer.

number of hours

lectures: 35
research: 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: 70; project design: 0; final exam: 30; requirements to take the exam (number of points): 30

references

Видаль П., Нелинейные импульсные системы, Перевод с французского Б. Ю. Мандровского-Соколова, Под ред. В. М. Кунцевича, Энергия, Москва, 1974.
Кунцевич, В. М., Чеховой, Ю. Н., Нелинейные системы управления с частотно- и широтно- импульсной модуляцие, Издательство „Техника“, Киев, 1970.

Non-linear strenght problems of rail vehicles

ID: PhD-3253
teaching professor: Simić Ž. Goran
ECTS credits: 5

goals

1. Deepening of knowledge in different areas of нon-linear strenght problems of rail vehicles.
2. Become acquainted with advanced methods and tools for the study of нon-linear strenght problems of rail vehicles.
3. Training for participation in research and development teams on the projects oф rail vehicles and their systems.

learning outcomes

After completion of the course a PhD student should be able to:

1. apply advanced computational methods and computer tools in calculation of non linear strength problems of railway vehicles.
2. analyze specific non-linear strength phenomena of rail vehicles.
3. participates in defining the research programs of rail vehicle strength problems.
4. participate in the critical evaluation of research results.
5. participates in drawing conclusions about the quality of the research results
6. participate in proposing future research directions of specific strength problems of the railway vehicles.

theoretical teaching

Depending on PhD. thesis field following subjects will be more or less deeply studied.
Nonlinear modeling in the field of rail vehicles strength. Specific tools for calculations in different areas of the nonlinear strength.
Elastic elastomeric elements modeled in hiperelasticity area. Methods for determining material properties.
Material models in elasto-plastic area. Collision scenarios in rail traffic. Structural strength requirements that should be fulfilled in different collision scenarios. Types of elements for the kinetic energy absorbtion in collision of railway vehicles. The concept of vehicle headparts in order to reduce the consequences of a collision.
Residual stresses due to braking of railway wheels. Measures to reduce the risk of wheel fracture. Fracture toughness and its measurement methods on samples from the wheels of rail vehicles. Modeling the formation process of residual stresses during braking with brake shoes. Methods for measuring the residual stress. Methods for repairing wheels with impermissibly high residual stresses.

practical teaching

Student makes seminar paper from a selected area upon agreement with relevant teacher and mentor of doctoral dissertation.

prerequisite

Knowledge of the railway vehicles design at the master level course. Completed course of the strength of material the master level.

learning resources

Milutinović, D., Simić, G, Opterećenja i proračun točkova železničkih vozila, Mašinski fakultet, Beograd 2006.

Publications from the SCI list.

number of hours

lectures: 35
research: 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

ERRI Reports

Nonplanar Lifting Surfaces

ID: PhD-3376
teaching professor: Kostić A. Ivan
ECTS credits: 5

goals

The goal is that after attended course in Nonplanar Lifting Surfaces, students become familiar with the specific issues considering applications of different types of nonplanar wing and tail planforms, wingtips and wingtip devices, aimed to improve the overall aerodynamic efficiency of modern flying vehicles. Students will get acquainted with the contemporary CDF tools, which can be efficiently applied for such kind of aerodynamic analysis and design.

learning outcomes

After accomplishing the course, students acquire the knowledge in the specific domain of nonplanar lifting surface aerodynamics. They will be able to rationally select, configure and perform basic optimizations of different aerodynamic devices, that would lead to the increased overall aerodynamic efficiency of a given aircraft.

theoretical teaching

Types and characteristics of lifting surfaces. Planar and nonplanar lifting surfaces. Mathematical modeling of lifting surfaces. Biplane and multiple wing designs. Winglets and wingtip devices. Witcomb winglets, blended, elliptical and spiroid winglets. Tip fences, tip sails, vortex diffusers. Wing-grid tips. Split wingtips. C-wing concept. Boxplanes, joined wings, lifting struts. Ring wings. Hyperelliptic wings. Grid fins. CDF modeling and analysis of nonplanar lifting surfaces.

practical teaching

prerequisite

None.

learning resources

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

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0; test/colloquium: 20; laboratory exercises: 0; calculation tasks: 0; seminar works: 0; project design: 50; final exam: 30; requirements to take the exam (number of points): 21

references

I. Kostić, Z. Stefanović: Nonplanar Lifting Surfaces - handouts, University of Belgrade, Faculty of Mechanical Engineeering, Belgrade, 2012.
I. Kroo: Nonplanar Wing Concepts for Increased Aircraft Efficiency, von Karman Institute lecture series on Innovative Configurations and Advanced Concepts for Future Civil Aircraft, 2005.
J. Katz, A. Plotkin: Low Speed Aerodynamics from Wing Theory to Panel Method, McGraw-Hill Co., Singapore, 1991.
S. M. Belotserkovskii: The Theory of Thin Wings in Subsonic Flow, Plenum Press, New York, 1967.

Nozzle Design and Flow Analysis

ID: PhD-3374
teaching professor: Stefanović A. Zoran
ECTS credits: 5

goals

Objective of the Course is providing insight in the fundamentals and physics, mathematical modeling, design and analysis of various types of nozzles. The Course is set up to deliver engineering tools for advanced propulsion problems.

learning outcomes

Upon completion and passing the course the student is expected to understand concepts and problems addressed in the field of nozzle applications. It is expected that the student knows how to apply the acquired knowledge in this field to solve practical engineering problems in the area of propulsion.

theoretical teaching

Basic nozzle design: convergent and convergent-divergent nozzles. Basic nozzle types and their applications. Ideal nozzle concept (characteristics flow zones & methods of analyses). Conical, bell, double bell, annular, spike and expansion-deflection nozzles, etc. Advanced nozzle design problems. Flow separation in the nozzles. Application of CFD in nozzle flow analysis (1D, 2D and 3D software). Principles of work & overview of existing types of TVC systems. Configuration vs. motor requirements. System design; component design (movable nozzle vs fixed nozzle. Design of gimbals mounts and interconnecting elements. Structural analysis; material selection; manufacturing; testing; inspection

practical teaching

Practical part of course demonstrate the numerical examples in all ranges of nozzle applications. Practical work of students is realized through a virtual classroom available 24 hours (program MOODLE). In the workshop students have approach to the professor's written notes, lectures and tests for practice. Each student works and study individually.

prerequisite

none

learning resources

This Course has a virtual classroom on the Internet. At the first lecture students are enrolled and trained for work (Moodle software). In the workshop approach is performed with the lectures and exercises, guidelines for project design, internet resources, etc.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

of points): 30

references

Zoran Stefanović, Marko Miloš: Handouts for Nozzle Design and Flow Analysis, Faculty of Mechanical Engineering, 2012.
P.Blocker : A Method of Characteristics Nozzle Design and Analysis Code with Improved Throat Modeling, Mississippi State University, 1995
E.Greitzer, C.Tan, M. Graf: Internal Flow, Cambridge University Press, 2004
Zucrow & Hoffman: Gas Dynamics, Vol 1 , Vol 2, John Wiley & Sons, 2005

Numerical methods

ID: PhD-3259
teaching professor: Spalević M. Miodrag
ECTS credits: 5

goals

Fundamental knowledge and understanding of methods in numerical mathematics. Qualifying of students for solving of problems in this area by using scientific acts and methods. Ability to follow contemporary achievements in the area of numerical mathematics and its applications, especially in technique and Engineering. Realization of numerical methods by using the program systems Matlab, Mathematica.

learning outcomes

Acquisition necessary theoretical knowledge and systematic understanding the problematic of the theory of numerical methods, its application in the other areas of mathematics, techniques and science. Mastering the skills and methods of research in this area. Deepening of a previously acquired knowledge from the lower levels of studies.

theoretical teaching

Elements of the errors theory. IEEE-754-2008. Classes singe and double in Matlab. Machine precision. Errors of approximate values of functions. Inverse problem for error. Condition of problem. Interpolation, Lagrange and Newton interpolation polynomials. Matlab function interp1. Numerical differentiation. Matlab function diff. Numerical methods for solving of nonlinear equations and systems. Interpolation quadrature formulas. Matlab functions integral, trapz. Methods of error estimation. Generalization to multiple integrals. Construction of Gauss formulas from Jacobi matrix by QR algorithm. Modification of Gauss formulas. Radau and Lobatto quadratures. Kronrod schemes. Gauss-Turán quadratures and generalizations. Convergence of quadrature processes. Formulas of trigonometric type. Integration of fast oscillating functions. Interpolating cubature formulas. Review of cubature formulas for some specific areas and certain weight functions. Numerical linear algebra. Gassuian elimination. LU factorization. Perturbation analysis. Iterative methods. Functions linsolve, lu in Matlab. Approximation theory. Bernstein theorem. Least squares approximation. Discrete least squares approximation. Chebyshev mini-max approximation. Implementation of linear and nonlinear regression in Matlab. ODE. Cauchy problem. Euler methos. Convergence analysis. Crank-Nickolson method. Zero stability. Stability on unbounded intervals. Higher order methods. Predictor-corrector methods. Systems of ODE. Runge-Kutta methods. ODE functions family in Matlab. PDE. Classification. Elliptic equations. Variational formulation of the Dirichet problem. Neuman problem. Finite difference method. Finite element method. Eigen value problem for elliptic operator. Parabolic equations. Variational formulation. Hyperbolic equations. Finite difference methods. Finite element methods. PDE toolbox in Matlab.

practical teaching

prerequisite

The course attendance conditions is determined by the curriculum of study program.

learning resources

1. M.M. Spalević, M.S. Pranić, Numerical methods, Skver, Kragujevac, 2007 (http://mat.mas.bg.ac.rs)

2. G.V. Milovanović, M. Kovačević, M. Spalević, Numerical mathematics - Collection of solved problems, University of Niš, 2003
(http://mat.mas.bg.ac.rs)

3. G.V.Milovanović, Numerical analysis, Parts 1, 2, 3, Naučna knjiga, Beograd, 1991

4. B.S. Jovanović: Numerical methods for solving PDE, Math. Institute, Beograd 1989, pgs. 130

5. G. Mastroianni, G.V. Milovanović: Interpolation Processes - Basic Theory and Applications, Springer Monographs in Mathematics, Springer – Verlag, Berlin – Heidelberg, 2008, XIV+444 pp.

6. W. Gautschi, Orthogonal Polynomials: Computation and Approximation, Oxford University Press, Oxford, 2004

7. W. Gautschi, Numerical Analysis: An Introduction, Birkhäuser, Boston, 1997

8. A. Quarteroni, F. Saleri, Scientific Computing with MATLAB, Springer, 2003.

9. S. Larsson, V. Thomee, Partial Differential with Numerical Methods, Springer, 2005

10. Software Matlab

11. Software Mathematica

number of hours

lectures: 35
research: 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: 60; project design: 0; final exam: 30; requirements to take the exam (number of points): 0

references

G. Mastroianni, G.V. Milovanović: Interpolation Processes - Basic Theory and Applications, Springer Monographs in Mathematics, Springer – Verlag, Berlin – Heidelberg, 2008, XIV+444 pp.
W. Gautschi, Orthogonal Polynomials: Computation and Approximation, Oxford University Press, Oxford, 2004
W. Gautschi, Numerical Analysis: An Introduction, Birkhäuser, Boston, 1997
A. Quarteroni, F. Saleri, Scientific Computing with MATLAB, Springer, 2003
S. Larsson, V. Thomee, Partial Differential with Numerical Methods, Springer, 2005

Numerical simulation of welding processes

ID: PhD-3251
teaching professor: Sedmak S. Aleksandar
ECTS credits: 5

goals

Understanding the basic principles of welding technology as a prescribed course of action to be followed when making a weld. Introducing students to techniques of material selection, preparation, preheating, methods and control of welding and subsequent thermal treatment. Introducing students to the application of numerical methods in analysis and simulation of welding processes. Understanding and studying the problem of coupled external load of welded structures. The development of independent and practical work using licensed software.

learning outcomes

By attending the course the students are mastering the basic knowledge of welding technology. Theoretical considerations and computational examples enable the student to master all the necessary principles of welding technology needed for the manufacture of welded joints. Introducing students to current modern standards and recommendations in this field. By attending this course students will master advanced use of finite element method, especially in the field of welding and welded structures. Theoretical considerations, computational examples and work by using licensed software, enables students to link previously acquired knowledge of mathematics, mechanics, construction and mechanical resistance of materials for application in engineering practice.

theoretical teaching

Defining the prior specification of welding technology (PSWT). Qualification of welding technology (QWT). Specification of welding technology (SWT).Heat treatment after welding. Welding sequence. Solving nonlinear problems by FEM; types of nonlinearities, review. Introduction to non-linear materials, the basic theory of plasticity. Presenting various criteria of plastic flow of material in the FEM. Connections between strains and stresses in the plastic field - and the flow law in the FEM formulation. Influence of reinforcement material. The influence of material anisotropy. The case of heterogeneous materials - application of welded joints. Problems porous materials. Viscoplasticity. Algorithms solving nonlinear problems; incremental - iterative procedures. Viscoelasticity. Presentation of thermal stress, coupled by FEM analysis. Application of different welding processes. The techniques of introducing residual stress.

practical teaching

Solving exercises in specification of welding technology - examples include various types and thicknesses of the base metal, welding process and position. Solving exercises in qualification of welding technology - examples include various types and thicknesses of the base metal, welding process and position.Constitutive expression of non-linear material behavior. Examples of formulations in the FEM. The formation of the real stress – strain curve. Special cases. Development of FEM models of welded joints and elastic-plastic analysis. Design of a FEM model of the welded joint and the elastic-plastic analysis. The application of different algorithms solving nonlinear problems, convergence and accuracy of the solution. Developments of FEM contact models. Post-processing. Techniques of introducing residual stresses - application on different welding procedures. FEM solutions in assessing fracture integrity of the weld. Numerical simulation of welding processes.

prerequisite

learning resources

[1] Written lessons from lectures (handouts)
[2] A. Sedmak, Use of the fracture mechanics on the structure integrity assessment, Faculty of Mechanical Engineering, Belgrade, 2003.
[3] M. Kojic, Computational Prrocedures in Inelastic Analysis of Solids and Structures, Kragujevac, 1997.
[4] M. Sekulović, Finite Element Method, Faculty of Civil Engineering, Belgrade, 1988.
[5] S. Sedmak et al., The Challenge od Materials and Weldments, SSIL, Belgrade, 2008.
[6] AWS, Welding handbook, 9th edition
[7] S. Sedmak, A. Sedmak, Experimental and numerical methods of fracture mechanics in structural integrity assesment, TMF, Belgrade, 2000.

number of hours

lectures: 35
research: 0

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): 0

references

Kojic M., Computational Prrocedures in Inelastic Analysis of Solids and Structures, Kragujevac, 1997.
R.W.Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, New York, 1996.
L. Pook, Metal Fatigue What It Is, Why It Matters, London, Springer, 2007.

Numerical Structural Analysis

ID: PhD-3255
teaching professor: Simonović M. Aleksandar
ECTS credits: 5

goals

Study of theoretical backgrounds and applying of advanced structural numerical analysis methods. Development of creative abilities for R&D and specific engineering problems approach using advanced structural numerical analysis methods.

learning outcomes

Vast and comprehensive field of structural analysis problems is covered with contemporary numerical methods of structural analysis. Advanced Numerical methods for structural analysis included enable extended analysis of structures of various types and materials.

theoretical teaching

Principles, equations and nomenclature. Equations of elasticity, elastoplastic materials, viscoplastic materials. Lattice structures and elements. Line elements, curvature beam elements. Plates and Shells. Volume problems. Linear dynamic and stability. Forced vibration of linear systems. Semianalytic methods. Applying Finite element Method for specific problem solving. Nonlinear problems. Finite element discretisation of nonlinear structures. Numerical methods of linear system equation solving. Adaptive techniques.

practical teaching

prerequisite

learning resources

number of hours

lectures: 35
research: 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

G.R. Liu, V.B.C. Tan, X. Han, Computational Methods Part 1, - Springer 2006.
G.R. Liu, V.B.C. Tan, X. Han, Computational Methods Part 2, - Springer 2006.
A.V. Perelmuter, V.I. Slivker, Numerical Structural Analysis - Methods, models and pitfalls, - Springer 2003.
Z.Bittnar, J.Sejnoha., Numerical Methods in Structural Mechanics, -Tomas Telfold 1996.
M. Sathyamoorthy, Nonlinear Analysis of Structures, - CRC Press 1998.

Operating Systems in Mechatronics

ID: PhD-3224
teaching professor: Radojević LJ. Slobodan
ECTS credits: 5

goals

The aim of the subject is to introduce a PhD student with some algorithms that are typical for programming operating systems Mechatronic devices. In this case, the typical algorithms for autonomous robotic Mechatronics systems. These algorithms have a basic feature: through time they are online.

learning outcomes

The doctoral candidate will identify processes that are characteristic of Mechatronics systems and processes at the same time operating system. Also, the doctoral candidate will be able to divide complex processes mechatronic systems in more simple process.

theoretical teaching

1. Banker's algorithm without feature process.
2. Banker's algorithm with the features of the process.
3. Classic Round Robin - RR algorithm.
4. Non-classical RR algorithm.
5. Processes with urgent priorities in the non-classical RR algorithm.
6. Processes with highest priorities in the non-classical RR algorithm.
7. Standard priority processes in non-classical RR algorithm.

practical teaching

PhD student will become familiar with the work of RR algorithm and servicing process. Recognize different processes characteristic of Mechatronics systems and apportioned them according to features that will mapped in priorities. Nonclassical RR algorithms allow different treatment processes were characterized with priorities. Analyzing a number of Case studies Ph.D. candidate will identify processes of three classes: urgent, high-priority, and classical.

prerequisite

C or C++

learning resources

The necessary software for this course under the GNU license - free of charge.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 0; calculation tasks: 0; seminar works: 45; project design: 0; final exam: 50; requirements to take the exam (number of points): 50

references

Operational Strength

ID: PhD-3088
teaching professor: Janković D. Miodrag
ECTS credits: 5

goals

Analysis, features and statistical analysis of the operational load. The influence of the operating loads on the fatigue damage. The basic principle of fatigue damage accumulation hypotheses and theirs classification. Calculations of working ability, operational strength, security and reliability and operational life of machine parts and machines exposed to varying operational loads. Experimental methods for fatigue strength estimation and treating of results.

learning outcomes

Methods for registration and statistical analysis of the operational load, the formation of its histograms, the distribution functions, spectra and blocks. The definition of fatigue damage and the process flow of its accumulation using theoretical and experimental methods with appropriate damage hypotheses. Establishment of appropriate criteria for the occurrence of critical fatigue damage phenomena and determination of operational fatigue life. The reduction of results from the variable spectra to equivalent results for the full constant amplitude spectra.

theoretical teaching

Study of methods of statistical processing flow variable load in the work and to reduce the load spectra or blocks. Various hypotheses about the flow and accumulation of fatigue damage criteria for the occurrence of critical phenomena - crack or fracture. Comparison of some hypothesis with advantages and disadvantages. Palmgren-Miner hypothesis, its assumptions, advantages and disadvantages. Various modifications of this hypothesis. Experimental methods for Fatigue and working life and ways of presenting the results. Using these results as a basis for a generalized linear hypothesis of fatigue damage accumulation and a more accurate determination of the fatigue life of a spectrum that is different from the experimental.

practical teaching

Instructions for the statistical analysis of an arbitrary on line operational load flow and the formation of spectra and blocks - the project task. Application of some hypotheses for determination of operational fatigue life and operating strength for a given range of variable load or stress relating to the case of full constant all amplitudes which are equal to the maximum amplitude of the variable spectrum. Examples for numerical determining of fatigue life by applying the Palmgren-Miner hypothesis and its modifications. Testing of some hypotheses using existing experimental results in the literature. Instructions for project work on the implementation of fatigue damage accumulation hypotheses at variable amplitudes for fatigue life estimation. Determining of structure mass reduction by apply the analysis of operational fatigue strength.

prerequisite

Desirable: Attended and passed the examen in the subject at the undergraduate level: Fundamentals of machine design - electiv subject.

learning resources

Laboratory with testing machines.

number of hours

lectures: 35
research: 0

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): 0

references

Gassner, E.: Operational Strength, special edition from Lüger Lexikon der technik, Stuttgart, in german.
Haibach, E.: Operational Strength (Betriebsfestigkeit - Verfahren und Daten zur Bauteilberechnung), VDI Verlag, Düsseldorf, 1989, in german.
Collins, J. A.: Failure of material in mechanical design, J. Wiley&Sons, New York, 1981, in english.
Dowling, N. E.: Mechanical behavior of Materials, Pearson, Prentice Hall, Upper Saddle River, 2007, in english.
Buxbaum, O. Operational Strength (Sichere und wirtschaftliche Bemessung schwingbruchgefärdeter Bauteile), 1992

Optimization and design of machinery and equipment for production and processing of food

ID: PhD-3150
teaching professor: Marković D. Dragan
ECTS credits: 5

goals

1. Introduction to development trends in food production and processing;
2. Gaining theoretical basis for the design of machinery, equipment and devices in biotechnology;
3. Design manufacturing processes and technological lines for the production and processing of food products and learning the methods of optimization;
4. Acquisition of practical skills in the analysis of the set of engineering problems and its solution-disciplinary approach;
5. Introduction to the general principles and guidelines for the design and development of a system of food safety management.

learning outcomes

1. The fundamental knowledge of technological processes and mastering bio production optimization methods.
2. Fundamental knowledge in the field of design and technological lines and processing of agricultural products.
3. Acquisition of practical skills in designing lines for food production and processing and its application to practice.
4. The student should be able to connect with the basic engineering knowledge development trends in food production and processing as well as for the application of knowledge engineering innovation in the field of biotechnology.
5. Train students through a set of algorithmic procedures, following the dynamics of technological processes and lines, make a decision in the design process of product development in general.

theoretical teaching

1. The materials for the food industry and biotechnology - the division, the characteristics and behavior of materials, structures, materials, material selection;
2. Unit operations in food production and processing
3. Dynamics and control process
4. Transportation systems and pipelines, joints and supporting structures;
5. Transport routes in the building - people, raw materials, by-products, finished products, packaging, waste, energy, transport vehicles;
6. Material - energy balances;
7. Optimization of equipment and resources;
8. Modern trends in food technology
9. Requirements of food production - standards and regulations relating to machinery, equipment and facilities;
10. Project documentation - conceptual design, the mechanical design, other projects of interest;
11th The share of engineers in the building life cycle - from concept to commissioning the plant operation.

practical teaching

Making the conceptual design of complete production lines for the production and processing of food products by choice. The project includes:
- Analysis of the election process and cooling equipment in accordance with the terms of reference,
- Capacity analysis, calculation and selection process and cooling equipment,
- Technical description of the equipment,
- Proposed layout of equipment in the factory and stored in part,
- Analysis of the energy balance and fluid
- Analysis of the technological methods of processing,
- Analysis of the need for raw materials,
- Define the transport of raw material and finished products,
- Definitions requires specific equipment for the facility (the minimum required dimensions, minimum load floor, the requirement for ventilation, as well as any other specific requirements that differ from the standards for this type of facility), to be used as a basis for the development of the facility,
- Economic analysis of the project.

prerequisite

learning resources

- MFB Skriptarnica
-Laboratory of Structural Development of Agricultural Machinery

number of hours

lectures: 35
research: 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: 0; project design: 50; final exam: 50; requirements to take the exam (number of points): 50

references

Myer Kutz : Mechanical Engineers' Handbook, A Wiley-lnterscience Publication, JOHN WILEY & SONS9 INC., 1998.
Marcus Karel, Darvl B. Lund: Physical principles preservation of food, Marcel-Dekker, New York, 2003.
D. R. Heldman.; D. B. Lund.: Handbook of food engineering; Taylor & Franncis Group; New York, 2007.
James G. Brennan: Food Processing Handbook, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2006.
Eminent example project.

Optimization in Thermal Power Engineering

ID: PhD-3387
teaching professor: Petrović V. Milan
ECTS credits: 5

goals

1. The achievement of research and expert competence in optimization in thermal power engineering.
2. The achievement of high level of theoretical knowledge
3. The acquisition of research and expert knowledge to optimize thermodynamic cycle (steam turbines cycles, gas turbine cycles, combined cycles).
4. The achievement of the techniques of process modeling.
5. Mastering the methods of experimental work in thermal power engineering.

learning outcomes

1. Expert and research deep knowledge of optimization in thermal power engineering
2. The development of critical thinking about energy use, fuel efficiency and environmental preservation
3. The optimization the steam turbine and gas turbine power plants.
4. Ability to use computer technology for modeling and calculations

theoretical teaching

Energy economics: Cost of electricity. Net present value. Economic evaluation methods. System Performance Characteristics and Selection: Performance. Construction costs. Fuel cost. Operation and maintenance cost. Availability and forced outage rates. Energy generation technology mix. Load distribution. Simulation of components. System simulation. Optimization: Mathematical model construction. Method of optimization for single-variable functions. Method of optimization for multivariable functions. A simplified cost optimization Project: Complex example of electricity cost calculation.

practical teaching

Project: Complex example of electricity cost calculation.

prerequisite

PhD student - Thermal power engineering

learning resources

Literature. Computing devices

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Petrovic, M: gas turbines and Turbocompressors, scrip, 2004.
Stojanovic, Themal Turbomachinery, Gradjevinska knjiga, Belgrade, 1967.
A.Bejan, G. Tsatsaronis, M. Moran: Thermal Design and Optimization, Wiley, 1996.
K.W.Li, A.P. Proddy: Power Plant System Design, Wiley, 19985
A. Bejan, Advanced Engineering Thermodynamics, 3rd ed., Wiley, 2006.

Optimization of aerospace structures

ID: PhD-3257
teaching professor: Simonović M. Aleksandar
ECTS credits: 5

goals

Study of theoretical backgrounds and applying of contemporary optimization methods related to aerospace structures. Development of creative abilities for R&D and specific engineering problems approach using appropriate advanced optimization methods.

learning outcomes

Vast and comprehensive field of optimization of aerospace structures problems is covered with contemporary methods. Advanced methods for optimization of aerospace structures included, enable solving of optimization and design problems for contemporary aerospace structures of various types and materials.

theoretical teaching

Comply with the subject of the research of the candidate's doctoral thesis

practical teaching

prerequisite

learning resources

number of hours

lectures: 35
research: 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

R. Ganguli, ENGINEERING OPTIMIZATION: A MODERN APPROACH, CRC Press, 2012
X.-S Yang, NATURE INSPIRED METAHEURISTIC ALGORITHMS, Luniver Press, 2010
V.Vsiliev, Z.Gurdal, OPTIMAL DESIGN THEORY AND APPLICATIONS TO MATERIALS AND STRUCTURES, Technomic, 1999
Selected Journal Articles

Organization and methods of scientific research and communication

ID: PhD-3192
teaching professor: Nedeljković S. Miloš
ECTS credits: 5

goals

Guiding and learning students into methodology and organization of scientific and research work. Learning the use of contemporary tools for gathering and analysis of information. Learning of research methods - analytic and experimental. Learning standards in communication in international scientific environment. Learning how to write scientific reports and papers. Learning how to present the achieved results.

learning outcomes

Applicable knowledge on how to organize scientific and research work. Application and use of contemporary tools for gathering and information analysis. Critical approach to research methods. Knowledge of standard communication methods in international scientific community and establishing of international information exchange. Knowledge on how to write scientific reports and papers and its application. Knowledge on how to present the gained results.

theoretical teaching

Methods of organization of scientific and research work - environment, information possibilities, resources needed, plan of investigation, background for investigation and adding up of contemporary novelties incorporating self investigations. The use of contemporary tools for gathering and information analysis - libraries, internet, information exchange by personal contacts. Research methods - analytic, experimental and synthetic. Standard methods of communication in international scientific community - text editors, programming languages, diagrams, results description. Writing of scientific papers and reports - organization, contents, language, conclusions. Presentation of results - equipment and programs for it, the way of slides preparation, oral communication.

practical teaching

Preparation of the exam in groups - computer search for relevant scientific information, writing of the research paper, computer and oral presentation of the work.

prerequisite

learning resources

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Недељковић М. Препоруке за припрему и излагање научно-стручних радова. часопис «Процесна техника», ISSN 0352-678X, вол..10, бр.1, стр.12-14,Београд 1994.
Dale MG. How to write and publish scientific paper. Oxford University Press, 1993.

Oscillations of a Mechanical Systems

ID: PhD-3172
teaching professor: Mitrović S. Zoran
ECTS credits: 5

goals

Introduce students to the basic concepts of linear and nonlinear oscillations and oscillations of elastic bodies.

learning outcomes

By gaining knowledge in this course, students will be able to effectively solve complex problems of linear and nonlinear oscillations and oscillations of elastic bodies.

theoretical teaching

Stability of equilibrium of the conservative system. Linearization of the differential equations of motion. Vibration of the conservative system. Frequencies. The main mode shapes of vibration. Modal matrix. Vibration of the body on the beam supports. Damped vibration. Forced undamped vibration. Forced vibration. Resonance. Forced damped vibration of the system. Oscillations (free and forced) of elastic bodies with constant and variable cross-section. Oscillations (free and forced) of plates and membranes. Properties of nonlinear oscillations. Testing of stationary systems with one degree of freedom. Phase plane, phase portraits and singular points. Lyapunov theorem. Construction of phase trajectories. The concept of auto - oscillation. Degenerative systems and the hypothesis of a jump. The effect of external harmonic force on auto - oscillation of systems with one and two degree of freedom. Stability of boundary trajectories.

practical teaching

prerequisite

Defined by the curriculum study of Phd studies program.

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.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 50

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.
Butenin N. V., Elements of nonlinear vibrations theory, Faculty of Mechanical Engineering, Belgrade 1985.
Rao S.S.: Mechanical vibrations, Addison-Wesley Publishing Company Inc., 1995.

Perfomance Analysis of Manufacturing Systems

ID: PhD-3011
teaching professor: Babić R. Bojan
ECTS credits: 5

goals

This course introduces analytical approaches for modeling and analyzing manufacturing and production systems. Production systems, such as flow lines, are often operating in an uncertain environment, e.g. uncertain demand or random processing capacities. With respect to lean management principles, robust planning approaches need to consider such stochastic elements. In addition, the production process is often highly time-dependent, for example due to capacity ramp-ups, seasonal demand patterns, and decreasing machine reliability over time.
In order to support decisions for such uncertain and dynamic manufacturing systems we apply queuing theory. The basic concepts of this underlying theory are developed in sufficient detail. Several general concepts of robust planning are discussed. Additionally, analytical performance approximations are introduced and used to analyze economies of scale or the value of flexible capacities.

learning outcomes

Students learn to understand the impact of stochastic variations in production systems. After this course students are familiar with the theory and practice of capacity analysis of stochastic manufacturing systems. They learn to adapt and to apply analytical approximations and robust planning methods.

theoretical teaching

Components of manufacturing systems and their integration; Systems for material handling; Organization and management of FMS; FMS modeling techniques; The use of simulation in the design and management of FMS; The application of artificial intelligence techniques in the design and management of FMS; The concept of virtual factories.

practical teaching

Softwares for modelling and analysis of real systems based on discrete event simulation (lab work).

prerequisite

Defined by curriculum of study programme/module.

learning resources

(1) B. Babic, Handouts, University of Belgrade, Faculty of Mechanical Engineering, 2011, 18.1
(2) B. Babic, Electronic classrom for distance learning (http://147.91.26.15/moodle/), University of Belgrade, Faculty of Mechanical Engineering, 2011, 18.13
(3) AnyLogic simulation software

number of hours

lectures: 35
research: 0

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

Guy L. Curry, Richard M. Feldman (2011), Manufacturing Systems Modelling and Analysis, Second Edition, Springer Heidelberg Dordrecht London New York
J. Banks, J. S. Carson, B. L. Nelson and D. M. Nicol (2005), DISCRETE EVENT SYSTEM SIMULATION, 4th Ed., Pearson Education International Series.
H. Tempelmeier, H. Kuhn (1993), FLEXIBLE MANUFACTURING SYSTEMS - DECISION SUPPORT FOR DESIGN AND OPERATION, John Willey & Sons.

Planetary gear train

ID: PhD-3242
teaching professor: Rosić B. Božidar
ECTS credits: 5

goals

The main goal of this course for the student is to give the necessary knowledge of:
• Computer aided machine design,
• understanding general relations between the gear parameters and those of the basic rack,
• formulating the optimization problems for planetary gear train and identify critical elements.

learning outcomes

During this course, the student will carry out:
• Overview of design machine element,
• methodology for calculation the planetary gear trains,
• strategies for machine design.

theoretical teaching

1. Design strategies. Field of application. Design objectives. Design analysis and evaluation.
2. Preliminary design: design synthesis. Computer aided machine design.
3. Gears in mesh, contact ratio, interference and backlash.
4. Internal gears. Tooth profile an internal gear. Meshing geometry of an internal geair pair.
5. Axial and radial assembly, tip interference.
6. Kinematic structure of the planetary gear train.
7. Force analysis - forces produced by central gear in mesh with planet gears.
8. Instantaneous efficiencies during the contact period and overall efficiency for planetary gear train.
9. Tooth stresses and strengths for external and internal gears of planetary gear train.
10. Optimization of planetary gear train.

practical teaching

Consists of the laboratory exercises.
Projects are main component of this course.

prerequisite

Some knowledge of basic machine elements and mechanics. Computer programming in MATLAB.

learning resources

Laboratory for CAD and laboratory for experimental investigation of gear trains.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 15; calculation tasks:

10; seminar works: 40; project design: 0; final exam: 30; requirements to take the exam (number of points): 30

references

Joseph E. Shigley: "Mechanical Engineering Design", Mc Graw Hill
J.R. "The Geometry of Involute Gears", Springer-Verlag
H. Eschenauer, J. Koski, A. Osyczka: "Multicriteria Design Optimization", Springer-Verlag

Planning, Performing & Controlling Projects

ID: PhD-3334
teaching professor: Babić R. Bojan
ECTS credits: 5

goals

The purpose of the course is to present a systematic approach to the planning, performance, and control of projects. One goal of this course is to introduce students to techniques that will allow them to start, develop, and complete municipal, industrial or scientific projects more efficiently and effectively. General approach in this course has three parts: Describe the general requirements for planning, performing, and controlling projects; Explain how those requirements are applied through the use of examples; Learning through students' work on their own projects.

learning outcomes

Upon completing this course, students will be able to:
- Lead and manage people and resources.
- Applies concepts for communicating effectively with project teams, stakeholders, and sponsors.
- Demonstrates a strategic alignment between business needs and project outcomes.
- Assesses project risks.
- Can apply concepts for planning, executing, and controlling project activities to assure outcomes that meet stakeholder expectations.

theoretical teaching

• The Systematic Approach (Projects, Programs & People; Planning for Performance - Steps in Project, Concurrent Engineering; Phases of Project)
• The Conception Phase (Purpose, Goal and Activities)
• The Study Phase
• The Design Phase
• The Implementation Phase
• Project Management (Management Functions, Organizations, Styles; Project Staffing; Project Reporting; Project and Program Control, etc.)
• The Project Plan (Establishing of Responsibility for Tasks; Project Schedule; Costs and Budgets; Monitoring and Controlling a Project, etc.)
• Specifications and Reports (Preparing Specifications; Contracts and Change Notices; Trip and Meeting Reports; Periodic Project Reports, etc.)
• Modeling and System Design (The Need for Models, Human Factors Considerations, Modeling Applications, Model Interconnecting and Testing)

practical teaching

Project initiation phase – Creation of initiation report . Making of conception report, Feasibility report forming, Study phase – specifications. Design phase – work on design tasks. Fall term progress report, preliminary design report. Detailed design report. Project presentation.

prerequisite

Defined by curriculum of study programme/module.

learning resources

(1) B. Babic, Z. Miljkovic, Handouts, University of Belgrade, Faculty of Mechanical Engineering, 2010
(2) B. Babic, Z. Miljkovic, Electronic classrom for distance learning (http://147.91.26.15/moodle/), University of Belgrade, Faculty of Mechanical Engineering, 2011,

number of hours

lectures: 35
research: 0

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

Harvey Maylor, Project Management, Financial Times Press, 2010
Carl Chatfield and Timothy Johnson, Microsoft Office Project 2003 Step by Step, Microsoft Press, 2004

Power transmission of locomotives - control and optimization

ID: PhD-3140
teaching professor: Lučanin J. Vojkan
ECTS credits: 5

goals

The aim of the course is to introduce students with specific problems in the power transmission in locomotives (motor-train) and allow them to acquire the necessary skills to work in this field.

learning outcomes

The aim of the course is to introduce students with specific problems in the power transmission in locomotives (motor-train) and allow them to acquire the necessary skills to work in this field.

theoretical teaching

Working characteristics of hydrodynamic transmission. Coupling of the internal combustion engine and hydrodynamic inverter. Hydrodynamic coupling. Calculation of hydrodynamic inverter, one-dimensional method - analysis of losses, determine the flow field. Inverter in braking mode. Testing and maintenance of transmissions. Regulated asynchronous drive. Frequency and voltage regulation. Automatic process control. Control of the drive in real time.

practical teaching

Nothing

prerequisite

Finished course fundamentals of electrical engineering and construction in previous studies.

learning resources

Literature that is available in the Faculty Bookstore and Library; Handouts available on lectures; Internet resources (KOBSON).

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 100; requirements to take the exam (number of points): 0

references

B. Davidovic, V. Lucanin, Hydrodynamic transmission of railway vehicles, Faculty of Mechanical Engineering, University of Belgrade, Belgrade, 2001.
Lj. Krsmanovic, A. Gajic, Turbomachines, Faculty of Mechanical Engineering, University of Belgrade, Belgrade, 2006.

Principles and Concepts of Industrial Air Pollution

ID: PhD-3223
teaching professor: Radić B. Dejan
ECTS credits: 5

goals

Getting to know the candidates with problems and solving problems in the field of air pollution control with appropriate scientific methods; subject is made as an advanced course in the area of air protection at the doctoral studies.

learning outcomes

Upon completion of the course it is expected that the candidate has mastered the scientific knowledge pertaining to the analysis and evaluation of scientific papers, procedures and methods of analysis of sources of air pollution, laboratory work, as well as the advanced processes of modeling of the transport of solid and gaseous components in the atmosphere.

theoretical teaching

Atmosphere and meteorology. Sources, levels and effects of air pollution. Causes, types and characteristics of pollutants. Emission, immission, pollutants forming. Legal norms. Tendencies in the development of standards of purity of atmospheric air. Air pollution control. Emission measurement, the diffusion of pollutants in the atmosphere, the smells – the characteristics, methods of measurement. Methods and systems for exhaust gases and air purification. Primary and secondary measures to reduce emissions from industry. Design, construction and operation of the plant. Techno-economic effects and selection of plants. Stack height and the effect of treatment. Mechanical, hydraulic, electrostatic and chemical methods and units for exhaust gases purification. Protection measures during design, construction and operation of plants for exhaust gases purification.

practical teaching

Students work under the supervision of teacher one seminar paper that needs student to apply knowledge.
If needed laboratory work and visits to industrial facilities.

prerequisite

-

learning resources

Laboratory and computational equipment.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Calvert, S., Englund, H.M., Handbook of air polution technology, John Willey & Sons, New York, 1984.
Kiely, G., Environmental engineering, McGraw-Hill, 1998., ISBN 0-07-709127-2.
Manahan, S.E., Industrial Ecology, Environmental Chemistry and Hazardous Waste, Lewis Publishers, 1999., ISBN 1-56670-381-6
Beychok, M., Fundamentals Of Stack Gas Dispersion, 2005., ISBN 0964458802
Scinetific papers from Environmental Science and Technology, Chemosphere, Energy i sl.

Principles of modeling in process engineering

ID: PhD-3092
teaching professor: Jaćimović M. Branislav
ECTS credits: 5

goals

Introduction to the mathematical and physical modeling as a basis for research and practical engineering work in process engineering

learning outcomes

Gaining knowledge of mathematical and physical modeling in process engineering

theoretical teaching

Modeling - definition, basic concepts
Mathematical model - a mathematical description of the objects
Mathematical analysis of the results of the experiment (measurements)
The mathematical description of the fluidodynamic structure

practical teaching

Examples of mathematical modeling in process industry

prerequisite

learning resources

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10; test/colloquium: 50; laboratory exercises: 0; calculation tasks: 10; seminar works: 0; project design: 0; final exam: 30; requirements to take the exam (number of points): 70

references

Jaćimović B., Genić S., Heat Transfer Operations And Equaipment, 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.

Product Development in Mechanical Enfineering

ID: PhD-3200
teaching professor: Ognjanović B. Milosav
ECTS credits: 5

goals

Mastery of scientific methods for understanding of the process of knowledge transformation in technical system, of scientific methods for this methodology development, creative skills development for application of knowledge and information data. The study of the methodology of new products development, trends and tendencies of technical systems development in the future.

learning outcomes

PhD student introduced into research of methods for the new products development, ie. new technical systems development for the future. Introduced in a new area of propulsion research and development of methodology for encouraging creativity in the development of new technical systems.

theoretical teaching

Aspects of product development (technical, social, economic, ecological and aesthetic). Philosophy and vision in the development of products for mechanical engineering. Methodologies and tools in product development. Approaches in product development in engineering design and in industrial design (integrated, simultaneous, multi-disciplinary, collaborative, axiomatic, empirical, robust, virtual, ...). Creativity in product development and design, innovativeness. Knowledge engineering, information systems and decision-making in product development and design. Calculations, simulations, experiments (modeling, model production, 3D scanning and printing, virtual reality, testing of structures and components). Limitations and constraints in product development (user needs, technology needs, reliability and safety in operation, vibration, noise, ... - Design for Reliability, Design for Vibration and Noise, Design for Cost, Design for Quality, Design for User,. ...). Harmonization of requirements, constraints, properties and the environment (living and working environment).

practical teaching

Research processes, methods and tools for use in developing of new products i.e. new technical systems. Development of creativity oriented towards the development of new technical systems. Preparation and defense of the seminar work.

prerequisite

It is no conditions for subject attending.

learning resources

Laboratory for Engineering Design LECAD. Journals and conferences proceedings from key conferences in this field. Software for modeling and product development. 3D printer, etc..

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Pahl G., Beitz W.: Engineering Design – A Systematic Approach, Springer-Verlag, 1991.
Hubka V., Eder E.: Design Science – Introduction to the Needs, Scope and Organization of Engineering Design Knowledge, -Springer 1995.
Hales C., Gooch S.: Managing Engineering Design, Springer-Verlag London 2004.
Debenham J.: Knowledge Engineering, - Springer-Verlag 1998
Frankenberger E., Badke-Schaub P., Birkhofer H. (editors): Designers The Key to Successful Product Development, -Springer 1998

Production Planning and Control Systems

ID: PhD-3019
teaching professor: Bojanić O. Pavao
ECTS credits: 5

goals

Surveys the design, development, implementation and management of production planning systems, including master production scheduling, aggregate planning, material requirements planning, capacity and inventory planning and production activity control. Students will be exposed to contemporary approaches such as just-in-time, theory of constraints and the relationship of enterprise-level planning and control systems to the overall materials flow.

learning outcomes

Students should be able to articulate and apply the following tools and practices of production planning and control:
• The elements, processes, and technologies comprising the field of Manufacturing Planning and Control
• Enterprise Resource Planning (ERP)
• Material Requirement Planning system technologies
• Inventory flow and planning models – JIT, MRP, etc.
• Capacity planning
• Production Activity Control Techniques
• supply chain optimization, integration and transformation.

theoretical teaching

• The elements, processes, and technologies comprising the field of Manufacturing Planning and Control
• Enterprise Resource Planning (ERP)
• Material Requirement Planning system technologies
• Inventory flow and planning models – JIT, MRP, etc.
• Capacity planning
• Production Activity Control Techniques
• supply chain optimization, integration and transformation.

practical teaching

This course will enable to student learning by applying the techniques of Production Planning and Control through the project.

prerequisite

There are no prerequisites

learning resources

Handouts in e-form /In Serbian/. Instructions for laboratory exercises /In serbian/. Instructions for project design /In Serbian/. One-student-one-computer scheme in a computer room. Software tool for application development (Oracle, MS Access, Progress,...)

number of hours

lectures: 35
research: 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: 60; final exam: 30; requirements to take the exam (number of points): 50

references

Stephen N. Chapman: The Fundamentals of Production Planning and Control
Jorg Thomas Dickersbach and Gerhard Keller: Production Planning and Control with SAP ERP (2nd Edition)
Avraham Shtub: Enterprise Resource Planning (ERP): The Dynamics of Operations Management

Propulsion of projectiles

ID: PhD-3183
teaching professor: Micković M. Dejan
ECTS credits: 5

goals

The acquisition of contemporary knowledge in the field of interior ballistics and rocket propulsion.

learning outcomes

Students acquire advanced knowledge in the field of classical projectiles and missiles.

theoretical teaching

Two-phase interior ballistic models.
Erosion of the gun barrel.
Interior ballistic tests.
Experimental research methods in interior ballistics.
Modern rocket propellants.
Modeling of rocket engine performances in non-stationary regimes.
Optimization of propellant grain geometry.
Structural analysis of the propellant grain.
Subsystems of rocket engines with liquid propellants.

practical teaching

Two-phase interior ballistic models - calculation examples.
Erosion of the gun barrel - selected models.
Interior ballistic tests - preparation and measurements.
Experimental research methods in interior ballistics - new methods.
Modern rocket propellants - survey and analysis.
Modeling of rocket engine performances in non-stationary regimes - calculation examples.
Optimization of propellant grain geometry - selected examples.
Structural analysis of the propellant grain - finite elements method.
Subsystems of rocket engines with liquid propellants - practical solutions.

prerequisite

learning resources

1. Jaramaz, S., Mickovic, D.: Interior ballistics, Faculty of Mechanical Engineering, Belgrade, 2011. (in Serbian)
2. Steifel, G.: Gun propulsion technology, Progress in astronautics and aeronautics, Vol. 109, New York, 1988.
3. Sutton, G.P., Biblarz, O.: Rocket propulsion elements, Wiley, 2010.
4. Davenas, A.: Solid rocket propulsion technology, Pergamon, 1992.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Krier, H.: Interior ballistics of guns, Progress in astronautics and aeronautics, Vol. 66, New York, 1979.
Hill, P., Peterson, C.: Mechanics and thermodynamics of propulsion, Pearson, 2010.

Quality, Assurance and Tests

ID: PhD-3339
teaching professor: Petrović I. Zlatko
ECTS credits: 5

goals

To educate students to design, survey and study quality sistems of products and services. To educate students to design measuring testing procedure to estimate quality of manufactured product.

learning outcomes

Abbility to design and leed quality system of products and services.

theoretical teaching

Introduction to quality assurance and quality control. Methods and means of Quality control. Quality and value, different viwes of quality. Probability and statistics. Estimation of statistic parameters. Sampling Theory, Confidence intervals, Hypothesis tests. Measurements, tolerances and quality. Statistical quality control. Quality managment.

practical teaching

Each topic is illustrated by practical examples. After each topic students prepare answer to homework requirements. Finall exam is presentation of seminar work done during semester.

prerequisite

No prerequisites.

learning resources

Laptop, Beam projector.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 40; requirements to take the exam (number of points): 30

references

lectutre notes and lecture slides

Quality Engineering Techniques

ID: PhD-3144
teaching professor: Majstorović D. Vidosav
ECTS credits: 5

goals

Detailed study of quality engineering techniques and their application in models of quality management and other standardized management systems. Generating knowledge for practical application of quality engineering techniques in everyday engineering practice. Developing skills for improving the existing model of quality management models using different techniques of quality engineering consultancy.

learning outcomes

After completion of the teaching process, students will have the necessary knowledge for understanding, researching and resolving problems related to the implementation and improvement of good quality management practices and other standardized management systems. He will also be able and competent to engage in scientific research in this field.

theoretical teaching

Advanced models of quality management; correlation techniques inženjenjrstva quality models and quality management. Seven basic quality engineering techniques. Seven engineering quality management techniques. Seven advanced techniques inžnjerstva quality. Selected examples of application. Our research in this area. Research problems in this area.

practical teaching

Analysis of case studies of good practice application of quality engineering techniques. Analysis research problems in this area.

prerequisite

Faculty degree, primarily technical.

learning resources

1. Lectures for each lesson in electronic form (handouts).
2. Textbook of quality engineering techniques (in preparation).
3. Website to material objects under 1 includes a bibliography of reference books and magazines, leading organizations and major institutions in this area.
4. Technical base case - Laboratory for Production Metrology and TQM, which has the necessary equipment and licensed software for training in this subject.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Wiele, T., Advanced Quality Management, Springer Verlag, London, 2009.
Nakao, K., Quality Engineering, JUSE, Tokyo, 2010.
Majstorovic, V., Quality Products Management, Mechanical Engineering Faculty, Belgrade, 2005.

Quantitative Research Methods in Aviation

ID: PhD-3182
teaching professor: Mitrović B. Časlav
ECTS credits: 5

goals

This course will provide an in-depth study of quantitative research methods and associated uni-variate and bi-variate statistical techniques used to describe, explore, clean, analyze, and interpret numerical data. Emphasis will focus on integrating applied data analysis skills with conceptual understanding of methodological issues.
Also, introducing students to methods and organization of scientific research. Introduces the students to the types of documents produced by scientists. The study of the structure of scientific documents. Mastering methods for planning and carrying out projects.

learning outcomes

Ability to contribute to scientific research. Student's ability to create and prepare scientific publications.. Ability to organize and control scientific projects. Students will focus on scholarly application of quantitative methods to aviation-related topics and aviation data.

theoretical teaching

Topics will include: data management, variables, units of analysis, data scales, descriptive statistics (central tendency, variability), distributions, sampling theory, statistical assumptions, statistical inference, data integrity, outlier identification and handling, missing data handling, reliability, internal and external validity, measurement, measurement error, variable roles (predictor-outcome), study and experimental design, inductive-deductive scientific reasoning, causation, hypothesis testing, statistical significance, effect size, statistical power, statistical comparison of means, statistical tests of association, simple and multiple regression, data coding, graphic representation of data, and APA-style dissemination of findings.

practical teaching

After each topic students get homework whcih they submit to professor. At the end of lecture students present their the project. Quality of work and quality of presentation determine final exam mark.

prerequisite

No preconditions

learning resources

Computer laboratory, projector, laptop

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 0; calculation tasks: 0; seminar works: 40; project design: 30; final exam: 25; requirements to take the exam (number

of points): 0

references

Queuing Systems - Theory and Applications

ID: PhD-3391
teaching professor: Bugarić S. Uglješa
ECTS credits: 5

goals

The purpose of this course is to present mathematical theory that has application to the problems of design and analysis of queuing systems. Although these systems are usually very complex, it is often possible to abstract from the system description a mathematical model whose analysis yields useful information. Focus is based on service systems viewed as stochastic processes, exploiting the theoretical framework of queuing theory. Includes multi-disciplinary perspectives involving Engineering, Statistics, Psychology and Marketing.

learning outcomes

Course provides a rigorous treatment of basic models commonly used in modelling real servicing systems in areas such as: real life (banks, supermarkets, call centres, traffic, transport etc.), emergency centers (hospitals), material flow, maintenance, warehousing etc. Major outcome is to qualify researcher to use queuing models as a decision support and forecasting tools in order to ensure stability of service systems, operational quality of service etc. in a real world servicing systems.

theoretical teaching

Stochastics processes (nonhomogeneous Markov process & homogeneous Markov process (chain), Chapman–Kolmogorov equations forward and backward, irreducible process, ergodic process, limiting system state probabilities)
Birth-and-death processes (Pure birth process -Poisson process, Pure Death process -analytical solution in time, relations between arrival–service time and number of arrived–departure units).
Elementary queuing models (Single server system with finite storage, single server system without storage, single server system with infinite storage (system characteristics, transition rate matrix Q, state-transition-rate diagram, system of differential and linear equations, system characteristics)
Multi server queuing system with finite storage (Multi server system with finite storage–general model, system characteristics, transition rate matrix Q, state-transition-rate diagram, system of differential and linear equations, system characteristics)
Finite customer population queuing systems (Single server finite customer population systems, Multi server finite customer population systems (system characteristics, transition rate matrix Q, state-transition-rate diagram, system of differential and linear equations, system characteristics)
Bulk queues (Bulk arrival systems–arbitrary and constant group size, system characteristics, transition rate matrix Q, state-transition-rate diagram, system of differential equations, system of linear equations; Bulk service systems, system characteristics, transition rate matrix Q, state-transition-rate diagram, system of differential and linear equations, system characteristics).
The application of queueing theory (Decision making, relationship between average delay and service cost, definition of total costs, servicing costs and waiting costs, formulation of waiting-cost functions, definition of objective function, decision models: model 1 –unknown c, model 2 –unknown μ and c, model 3 –unknown λ and c).

practical teaching

Solving of working examples (Methodology of modelling, solving and optimising real problems

using queuing theory models)
Laboratory work i.e. use of existing software or writing adequate one.

prerequisite

Students should have (but not necessary) a background in probability, statistics, mathematics, computer science.

learning resources

1. Bugaric, U., Petrovic, D.: Servicing system modelling, Faculty of Mechanical engineering Belgrade, Belgrade, 2011.
2. Bugaric, U.: Methodology for analysis of single position machines work, Foundation Andrejevic, Belgrade, 2003.
3. Software: QtsPlus 3.0 (Queuing theory software Plus).
4. Software: IOR Tutorial (Interactive Operations Research).
5. Personal computers.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 100; requirements to take the exam (number of points): 0

references

Kleinrock, L, QueueingSystems-Volume 1 Theory, John Wiley & Sons, 1975.
Cooper, R. B., Introduction To Queueing Theory, Elsevier Nort Holland Inc. 1981.
Hillier, F. S., Lieberman, G. J.: Introduction to operations research (seventh edition), McGraw-Hill, New York, 2000.

Radiation heat transfer

ID: PhD-3246
teaching professor: Saljnikov V. Aleksandar
ECTS credits: 5

goals

Students shall gain knowledge in - radiation heat transfer - scientific discipline that forms a basis for the design of many devices and plants in process engineering, thermal engineering and powers engineering. Students should study: blackbody radiation; thermal radiation properties of surface; atmospheric and solar radiation; view factor; thermal radiation between black surfaces and thermal radiation between diffuse gray surfaces; radiation combined with the other modes of heat transfer, and - radiation heat transfer in absorbing, emitting and scattering media.

learning outcomes

After completing the course, passed quizzes and tests and successfully completed exam, students will be able to independently perform thermal calculations of simpler 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. Blackbody radiation - concept of black body, emission of black body, Stefan - Boltzmann law, Planck's spectral distribution of blackbody emission; Wien's displacement law.
2. Radiation properties - emissivity, absorptivity, reflectivity and transmissivity (spectral, total, directional and hemispherical); Kirchoff's law; the greenhouse effect; solar radiation.
3. View factor - definition; the reciprocity rule; the summation rule; the superposition rule; the symmetry rule; view factors between infinitely long surfaces, the crossed strings method.
4. Radiation between black surfaces and radiation between diffuse gray surfaces - net radiation heat transfer to (from) the surface; net radiation heat transfer between any two surfaces.
5. Radiation heat transfer in absorbing, emitting and scattering media. Radiation heat transfer in transparent and opaque gases. Radiation combined with the other modes of heat transfer.

practical teaching

1. Numerical exercises: - model of black body, emission of black body, Stefan - Boltzmann law, Planck's spectral distribution of blackbody emission; Wien's maxima displacement law.
2. Numerical exercises: - emissivity, absorptivity, reflectivity and transmissivity (spectral, total, directional and hemispherical); Kirchoff's law; the greenhouse effect; solar radiation.
3. Numerical exercises: - view factor; the reciprocity rule; summation and superposition rule; symmetry rule; view factors between infinitely long surfaces, the crossed strings method.
4. Numerical exercises: - radiation among multiple black surfaces; radiation among diffuse gray surfaces - net heat flux to (from) the surface; net radiation heat transfer among real surfaces.
5. Numerical exercises: - thermal radiation in absorbing, emitting and scattering media; thermal radiation in transparent and opaque gas. Heat radiation combined with conduction and convection.

prerequisite

Necessary: Physics, Thermodynamics B
Desirable: Basic heat transfer

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

lectures: 35
research: 0

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
R. Siegel, J.R. Howell: Thermal Radiation Heat Transfer, Hemisphere & McGraw Hill, 2008

Rationalization of Energy Consumption in Households and Industry

ID: PhD-3106
teaching professor: Komatina S. Mirko
ECTS credits: 5

goals

Examination of possibilities for improving the energy processes, devices thermal and technical characteristics, as well as the residential and office buildings. Thermodynamic and exergy analysis of the possible energy savings in households and industry. Technical and economical analysis, and environmental justification of efficient energy use.

learning outcomes

Students are being made capable to deal with the improvement of energy processes, and with the thermodynamic and exergy analysis of the possible energy savings. They are being thought how to use basic economical aspects of efficient energy use, as well as how to independetly and creatively apply their knowledge gained during their scientific and research work.

theoretical teaching

Fundamental significance of rational energy use. Potentials for increasing the energy efficiency in households and industry. Basic definitions and possibilities for calculating the energy efficiency of the processes, devices and buildings. State of law legislation in the EU countries and our country. Basic definitions and ways of calculating the energy efficiency of the devices, buildings and processes. Application of thermodynamic and exergy analysis on the calculation of possible energy savings in households and industry. Technical and economical analysis, and environmental justification of the application of measures for the rational energy use.

practical teaching

prerequisite

learning resources

number of hours

lectures: 35
research: 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: 50; project design: 10; final exam: 40; requirements to take the exam (number of points): 0

references

Energy-Efficient Building Systems, L. Jayamaha, McGraw Hill Professional, 2006
Exergy, energy, environment and sustainable development, Dincer, Rosen, Elsevier, 2007
Boris Labudović, Frano Barbir, Julije Domac et al.: Renewable Energy Resources, Power Industry Marketing, Zagreb. 2002.
Group of authors: The Sustainable Difference energy and environment to achieve the MDGs, Energy and Environment Bureu for Development Policy, New York, 2005.
Dincer, I., Zamfirescu, C.: Sustainable Energy Systams and Applicatins, Springer, 2011.

Realiability and dinamics of power transmission units

ID: PhD-3199
teaching professor: Ognjanović B. Milosav
ECTS credits: 5

goals

Mastering of knowledge and research methods of elementary reliability of power transmission components and the overall reliability of the gear transmission units. Mastering the research methodology of vibration and noise generation mechanism in these systems. Mastering the methodology of defining the structural parameters of the gear components based on reliability, vibration and noise design consraints.

learning outcomes

PhD student introduced to the research process of reliability, vibration and noise of gear transmission units.

theoretical teaching

An overview of the elementary reliability and application of this reliability as Design Constraint in design parameters definition. Elementary reliability of gears, bearings, couplings, seals, shafts, shaft joints and hubs, steering mechanism, etc. Correlation of reliability and probability of service conditions and the probability of failure of the gear unit components. Deduction of gear unit overall reliability to the level of components and defining of boundary levels. Disturbance processes in the gear units and vibrations and noise generation. Transmission of disturbance energy through the structure of the system. Principles of dynamic processes alignment with the limitations of the gear vibration and noise levels.

practical teaching

Research, examination of relevant references, experimental determination the probability of service and critical conditions of gear unit components elementary reliability. Vibration and noise testing of gear transmission unit components. Numerical analysis of dynamic parameters of gear unit components. Determination of design parameters. Preparation and defense of the seminar work.

prerequisite

No conditions

learning resources

Laboratory for gears and gear transmission units, Laboratory for vibration and noise, Software for numerical analysis - FEM, Software for vibration and noise measurement and for processing of measurement results.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Ognjanović M.: The noise generation in mechanical systems (in Serbian),- Faculty of Mechanical Engineering 1995.
Ognjanović M.: Reliability and safe service of structures , - Chapter in Monography "From fracture mechanics to structural integrity assessment", (333-352), Belgrade 2004.
Ognjanovic M.: Research of Power Transmission for Efficient Design, - Monography chapter “Konstruktionsmethodik fur Fahrzeugkonzepte” Braunschweig , Bericht Nr. 74, 2010, pp 139-157

Rehabilitation Biomechanics

ID: PhD-3125
teaching professor: Lazarević P. Mihailo
ECTS credits: 5

goals

Introduce students to the problems of medical devices on the example of a number of modern devices that are in widespread use in rehabilitation purposes. Train students to critically approach the problem and define the most important biomedical and other parameters of given rehabilitation device which is projected as well as parameters of patient or to optimal implement existing biomedical device in rehabilitation.

learning outcomes

PhD student acquire the basics of designing and applications of medical devices, studying this subject. Theoretical considerations, a detailed analysis of modern devices of practical use and self-development project, to connect the previously acquired knowledge in mathematics, physics, mechanics, electrical engineering with electronics and automatic control, to implement the lessons learned in engineering practice.

theoretical teaching

The basic concepts of assistive medical devices,rehabilitation biomechanics; defining the specifications of assistive medical devices on the basis of biomedical measurement using statistical analysis. Introduction to the basics of the functioning of assistive medical devices and defining the basic problems of designing assistive medical devices, as following: a pacemaker, defibrillator, artificial lung, cochlear implants and other devices for the sense of hearing and vision, implants and dentures in dental implants in orthopedics, prosthetics and orthotics for the arms and legs, wheelchairs,exoskeleton, neuro-controlled devices

practical teaching

Elaboration of detailed numerical examples and the following examples in designing assistive medical devices: pacemakers, defibrillators, artificial lung, cochlear implants and other devices for the sense of hearing and sense of vision. There will also be considered examples of implants and dentures in dental implants in orthopedics, prosthetics and orthotics for the hands and feet, wheelchairs,exoskeleton, neuro-controlled devices. In consultation with their faculty stuff, tudent will be required to develop the concept of working the assistive medical device as well as to project/analysis proposed assistive medical device

prerequisite

none

learning resources

[1]M.Lazarević,Design of Assistive Medical Devices,(script in preparation),2011
[2]Written abstracts from the lectures (Handouts)
[3]R.Khandpur,Biomedical Instrumentation:Technology and Applications,McGraw-Hill,2004.
[4]D.Prutchi, M. Norris,Design and Development of Medical Electronic Instrumentation:A Practical Perspective of the Design,Construction, and Test of Medical Devices,Wiley-Interscience, 2004.(KCJ)
[5]P.King,R.Fries,Design of Biomedical Devices and Systems,Marcel Dekker, 2003.(KCJ)

[6] M. Kutz,BIOMEDICAL ENGINEERING AND DESIGN HANDBOOK,McGrawHill,Vol.1,2,2009
[7]Ahmed A. Shabana,Computational Dynamics,John Wiley & Sons, Inc., 605 Third Avenue, New York, NY,2001

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

R. Fries,Reliable Design of Medical Devices,CRC Press Taylor & Francis Group,Boca Raton, Florida,2006
Thompson, S.G. , Neurorehabilitation Devices. McGraw Hill,2006
Bronzino JD. The biomedical engineering handbook. Boca Raton, FL: CRC Press; 2000.
Yoseph Bar-Cohen,Biomimetics, Biologically Inspired Technologies,CRC Press Taylor & Francis Group,2006
J. M. Justiniano, V. Gopalaswamy,Practical Design Control Implementation,CRC Press LLC, Boca Raton, Florida,2002

Reliability Mechanical Systems

ID: PhD-3082
teaching professor: Ivanović S. Gradimir
ECTS credits: 5

goals

The objectives of the course are to provide a comprehensive insight into the issues analysis and design in the areas of reliability of mechanical systems. The course is intended for doctor's students of all mechanical engineering, and it provides insight into the analysis and design of the reliability mechanical system.

learning outcomes

Mastering the study program a student obtains general and subject-specific skills which are in a function of the contemporary approach to the analysis and design of мецханицал systems. The students acquire ability to access the full access to today's analysis and design reliability, a perception of the life-cycle systems, and solving complex problems in this area.

theoretical teaching

Defining the requirements for reliability of mechanical system elements and system. Probability theory and its application in analysis and design reliability. Definition of failure of the elements and system. Determination of empirical and theoretical characteristics of reliability of the elements of a system and of the systems (histogram, polygon, intensity of failure, the function of frequency, mean value, distribution laws (Waybill, normal, exponential, binomial, Poisson), tests of trust, confidence interval). Determination of reliability block diagrams of simple and complex systems (vehicles) - with the application of probability theory of complex events. Fault tree analysis, The analysis of mode, effect and criticality of faults, Integrated system approach. The general methodology of designing the mechanical systems and its parts from the point of application reliability. Design of mechanical systems elements for a given level of reliability, relations of workload and critical load, the selection of intensity of failures for specific working conditions and environment. Laboratory testing of reliability. Information systems in the analysis of reliability system.

practical teaching

The event-failure. Probability theory and statistics. The compound probability. Determining the reliability characteristics of elements and mechanical systems. Reliability block diagram - connection of the elements in the system. Determining the function of system reliability (simple and complex). Design of reliability. Design based on work and critical loads. Allocation of reliability. Fault tree analysis, analysis methods, effects and criticality of failures. Laboratory testing of reliability. Information systems.

prerequisite

No previous preconditions.

learning resources

1. G. Ivanovic, D. Stanivukovic, I. Beker: The reliability of technical systems, Faculty of Mechanical Engineering, Belgrade, Faculty of Technical Sciences, Novi Sad, Serbian Army, 2010.
2. J. Todorovic, D. Zelenovic: Effectiveness of the systems of mechanical engineering, Science

book, Belgrade, 2010.
3. J. Todorovic: Engineering maintenance, Yugoslav Society of automotive engineers, Belgrade.
4. N. Vujanovic: The theory of reliability of technical systems.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Reliability vehicle

ID: PhD-3084
teaching professor: Ivanović S. Gradimir
ECTS credits: 5

goals

The objectives of the course are to provide a comprehensive insight into the issues analysis and design in the areas of reliability of motor vehiles. The course is intended for doctor's students of to students of Module for Motor Vehicles and it provides insight into the analysis and design of the reliability мotor вehicles.

learning outcomes

Mastering the study program a student obtains general and subject-specific skills which are in a function of the contemporary approach to the analysis and design of motor vehicles. The students acquire a basic ability to access the full access to today's analysis and design reliability, a perception of the life-cycle systems, and solving complex problems in this area.

theoretical teaching

Defining the requirements for reliability of motor vehicles and elements of motor vehicles. Probability theory and its application in analysis and design reliability. Definition of failure of the mothor vehicles. Determination of empirical and theoretical characteristics of reliability of the elements of (histogram, polygon, intensity of failure, the function of frequency, mean value, distribution laws (Waybill, normal, exponential, binomial, Poisson), tests of trust, confidence interval). Determination of reliability block diagrams of simple and complex vehicles - with the application of probability theory of complex events. Fault tree analysis, The analysis of mode, effect and criticality of faults, Integrated system approach. The general methodology of designing the motor vehicle and its parts from the point of application reliability. Design of motor vehicles elements for a given level of reliability, relations of workload and critical load, the selection of intensity of failures for specific working conditions and environment. Laboratory testing of reliability. Information systems in the analysis of reliability motor vehicle.

practical teaching

The event-failure. Пrobability theory and statistics. The compound probability. Determining the reliability characteristics of elements motor vehicle and motor vehicle as systems. Reliability block diagram - connection of the elements in the vehicle. Determining the function of system reliability (simple and complex). Design of reliability. Design based on work and critical loads. Allocation of reliability. Fault tree analysis, analysis methods, effects and criticality of failures. Laboratory testing of reliability. Information systems.

prerequisite

No previous preconditions.

learning resources

1. G. Ivanovic, D. Stanivukovic, I. Beker: The reliability of technical systems, Faculty of Mechanical Engineering, Belgrade, Faculty of Technical Sciences, Novi Sad, Serbian Army, 2010.
2. J. Todorovic, D. Zelenovic: Effectiveness of the systems of mechanical engineering, Science

book, Belgrade, 2010.
3. J. Todorovic: Engineering maintenance, Yugoslav Society of automotive engineers, Belgrade.
4. N. Vujanovic: The theory of reliability of technical systems.
5. G. Ivanovic: System Effectiveness, Faculty of Mechanical Engineering, Belgrade, Faculty of Technical Sciences, Novi Sad, 1978.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Renewable Energy Sources

ID: PhD-3104
teaching professor: Komatina S. Mirko
ECTS credits: 5

goals

To gain a comprehensive knowledge about renewable energy sources which are alternative to classical energy technologies. Introduction to processes and devices for exploitation of renewable energy sources. Studding about possibilities for retrofitting the fossil fuel facilities in order to adapt them to work with renewable energy sources. Thermo dynamical and techno-economical analysis of renewable energy sources utilization.

learning outcomes

Students will gain knowledge about renewable energy sources and possibilities for their use, as well as about methodology of thermodynamical analysis of devices utilizing renewable energy sources. Student will become capable to carry out independent research in this field.

theoretical teaching

Basics considerations about importance of renewable energy sources utilization. Possibilities of energy harvesting from RES. Legislation in this field in EU countries and Serbia. Thermodynamical analysis of devices imploying RES technology. Technoeconomical and ecological aspects of RES utilization. Basic characteristics, potentials and possibilities of RES utilization. Possibilities of substituting fossil fuels with RES. Possibility of electrical energy production from RES.

practical teaching

prerequisite

learning resources

number of hours

lectures: 35
research: 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: 50; project design: 10; final exam: 40; requirements to take the exam (number of points): 0

references

Fundamentals of renewable energy processes, Da Rosa,, Elsevier, 2009
Exergy, energy, environment and sustainable development, Dincer, Rosen, Elsevier, 2007
Обновљиви извори енергије, Б. Лабудовић, 2002.
Renewable Energy, G. Boyle, Oxford University Press, 2004.
Anne Maczulak, RENEWABLE ENERGY: Sources and Methods, Facts On File, Inc., New York, 2010.

Research, design and optimization of the tractor, drive and self-propelled agricultural machines

ID: PhD-3149
teaching professor: Marković D. Dragan
ECTS credits: 5

goals

1. Mastering the theoretical foundations of the machines-tractors and self-propelled agricultural machine-harvesters;
2. Mastering complex theoretical the basic movement of machine parts and assemblies of agricultural machinery, and optimization of their kinematic parameters;
3. Conception and construction of agricultural tractors and self-propelled chassis;
4. Transmission systems and machines to connect and work units; Optimizing transmission power machines in relation to its operating mode primarily machines;
5. Conceptions of simultaneous transfer of power through the drive wheels and towed back, energy balance and energy efficiency of machines;
6. The theory of operation, concept and design combines, budgets drive moving parts and technological devices combine;
7. Mathematical modeling methods of material flow through technological devices combine.

learning outcomes

1. The basic knowledge of the theory of work, conception and construction of power machines-tractors and self-propelled chassis and universal self-propelled combine harvester;
2. Analysis of mechanical, hydro-static transmissions and combined agricultural tractors, self-propelled chassis and universal self-propelled combine harvester;
3. The application of CAD / CAM facilities and construction of technological devices tractors and combines;
4. Application of FEM calculations in technological devices and drive tractors and combines;
5. Linking basic engineering knowledge and achievement of synergy;
6. Acquisition of practical skills and application in practice.

theoretical teaching

1. Introduction, theory of operation, the design and construction of the machines, tractors, and farm-propelled chassis;
2. Concepts of transmission and energy balance of simultaneous power transfer through the drive wheels and towed back;
3. Concepts, devices and systems to connect and aggregate formation tractor-working machines;
4. Structure and stress field theory of self-propelled combine harvester;
5. The calculations combine technological devices and their mathematical modeling;
6. Conceptions drive moving parts, hydro-static power transmission components selection and budget hydro-static drive moving parts and technological devices combine.

practical teaching

Lab exercise:
1. Practical introduction to the techniques of measuring non-electrical quantities in the hydraulic system of tractors and harvesters;
2. Practical introduction to the techniques of collecting data for Geographic Information Engineering in Agriculture and yield mapping.

Mathematical tasks:
1. Development of computational tasks using computers and modern software CAD / CAM package from the tractor;
2. Development of computational tasks using computers and modern software CAD / CAM packages in the field of universal self-propelled combine.

Development of the project:
1. Preliminary project in the field of tractors and self-propelled drive chassis;
2. Conceptual design in the field of universal self-propelled combine.

prerequisite

learning resources

- MFB Skriptarnica
- Laboratory of Structural Development of Agricultural Machinery

number of hours

lectures: 35
research: 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: 0; project design: 50; final exam: 50; requirements to take the exam (number of points): 50

references

CIGR-HANDBOOK Agricultural Engineering, Agro Processing Engeneering, ASAE, USA, 2006.
Srivastava K.A., Goering E.C.,Rohrbach P.R.: Engineering Principles of Agricultural Machines,ASAE, USA, 2003.
Roy Bainer, Principles of Farm Machinery, Read Books Design, 2010, ISBN1446523314
Gerhard Pahl, Ken Wallace, Luciėnne Blessing, Engineering design: A systematic approach, Springer, 2007, ISBN1846283191
Eminent example project.

Research & Development Methodology

ID: PhD-3336
teaching professor: Petrović I. Zlatko
ECTS credits: 5

goals

Introduce students to methods and organization of scientific research. Reckognition of main types of scientific documents and publications. Understanding of scientific document structure. Planning and execution of scientific projects.

learning outcomes

Ability to contribute (in a formal way) to scientific research. Ability to design and write scientific documents. Ability to organize and control scientific projects.

theoretical teaching

Introduction to Scientific Method, Elements of scientific method. Type and structure of scientific documents. Composition of scientific documents. Document styles. Presentation of scientific results and guidelines for presentation preparation. Technical report writing. Conducting Meetings. Project planning. Introduction to project Managment

practical teaching

After each topic students get homework whcih they submit to professor. At the end of lecture students present their seminar work. Quality of work and quality of presentation determine final exam mark.

prerequisite

No preconditions

learning resources

Computer laboratory, projector, laptop

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

lectutre notes and lecture slides

Risk Management

ID: PhD-3357
teaching professor: Misita Ž. Mirjana
ECTS credits: 5

goals

The main purpose of course is to: explain the basis and application risk-based and reliability approaches for inspection and maintenance, as given by EU and USA approaches (reliability, risk, availability, RCM, CMMS, RBI,..,). Learn about principles of risk-based inspection and reliability centered maintenance: Current risk and reliability based approaches in maintenance of industrial plants; Codes and standards RBM, BRI, RCM,; Importance of plant databases hosting risk-assessment - examples of leading software packages; Examples of current approaches: API (American Petroleum Institute), Risk based inspection and maintenance procedures for European industry (RIMAP)

learning outcomes

Development student's skills in:
- Data acquisition, Analyses, Results and reports using application risk-based approach in inspection and maintenance plants
- Bench marking of results for the certain plants: parallel application of PAI 581 and RIMAP approaches
- Representation of results.

theoretical teaching

1. Risk management framework. 2. Basic principles and methods of risk management. 3. Methods and standards for risk management. 4. Designing risk management framework. 5. The risk management process. 6. Implementation of risk management. 7. Qualitative risk assessment models. 8. Quantitative risk assessment models. 9. Statistical models for risk assessment. 10. Risk management tools.

practical teaching

Using R-Tech software for risk assessment.

prerequisite

Enrolled 3rd semester of doctoral studies.

learning resources

R-Tech API 581 software for risk assessment, by Stainbeis Transfer Center for Advanced Risk Technologies

number of hours

lectures: 35
research: 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: 0; project design: 90; final exam: 10; requirements to take the exam (number of points): 30

references

Training Course: Use risk-based approaches in inspection and maintenance of petrohemical plants, Steinbeis Foundation, 2006
Courses: Risk-based inspection according to API 581 and Reliability centered Maintenance, Steinbeis Foundation, 2006.
Kauer, R., Jovanovic, A., Ghermund-Vage, S.A., Plant Asset Management RIMAP the European Approach, ASME PVP-Vol. 488, July 25-29, 2004, San Diego, California, US
Jovanovic A., Balos D., Bareiβ J.M., Guntrum R., Krause U., Misita M. at all, 2010, Enhancing Industrial Safety, Environmental Protection and Risk Management in Serbia, Steinbeis Edition, Stuttgart.
Stanojevic, P., Orlic, B., Misita, M.,at all., On-line monitoring and assessment of emerging risk in conventional industrial plants, 2nd iNTeg-Risk conf., Stuttgart, 14-18.6. 2010, pp. 237-247

Risk Management

ID: PhD-3260
teaching professor: Spasojević-Brkić K. Vesna
ECTS credits: 5

goals

Training for self-use of risk management tools. Training for self-development of new models and improvement of existing models for risk assessment.

learning outcomes

By completing the program of this course students acquire following professional skills: 1. Risk management diagnosis in the company, 2 Application of risk management tools, 3 Improvement of existing risk assessment models and 4 Designing new models for risk assessment. Upon completion of the course, students attach more importance to risk managementfrom the point of viability, and are trained to use and improve the methods, techniques and models for risk management.

theoretical teaching

1. Risk management framework. 2. Basic principles and methods of risk management. 3. Methods and standards for risk management. 4. Designing risk management framework. 5. The risk management process. 6. Implementation of risk management. 7. Qualitative risk assessment models. 8. Quantitative risk assessment models. 9. Statistical models for risk assessment. 10. Risk management tools.

practical teaching

Case studies in the field of risk management.

prerequisite

Enrolled semester.

learning resources

1. Terje Aven and Jan Erik Vinnem, 2007., Risk Management With Applications from the Offshore Petroleum Industry, Springer Series in Reliability Engineering series ISSN 1614-7839, London
2. ESPRIT Course material - "Enhancing Industrial Safety, Environmental Protection and Risk Management in Serbia by means of dedicated Training, Education and Technology Transfer",2009.
3. Greg N. Gregoriou, Advances in Risk Management, PALGRAVE MACMILLAN, ISBN-13: 978–0–230–01916–4, 2009
4. Scientific papers from Scopus, Science Direct and other databases.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 0

references

Terje Aven and Jan Erik Vinnem, 2007., Risk Management With Applications from the Offshore Petroleum Industry, Springer Series in Reliability Engineering series ISSN 1614-7839, London
ESPRIT Course material - "Enhancing Industrial Safety, Environmental Protection and Risk Management in Serbia by means of dedicated Training, Education and Technology Transfer",2009.
Greg N. Gregoriou, Advances in Risk Management, PALGRAVE MACMILLAN, ISBN-13: 978–0−230−01916−4, 2009
Scientific papers from Scopus, Science Direct and other databases.

Security of Very Large Database System

ID: PhD-3382
teaching professor: Radojević LJ. Slobodan
ECTS credits: 5

goals

Goal of the subject is to present procedures to system design privileges for very large databases.

learning outcomes

Doctoral candidate after the completion of the subject, be able to design and program the application to control the users of large databases.

theoretical teaching

1. Defining table structure for a system of privileges for groups of users.
2. Defining relationships between tables in the system of privileges for groups of users.
3. Defining table structure for a single-user system privilege.
4. Defining relationships between tables in the system of privileges for a single-user.
5. Design methods for the control of a single-user belonging to a particular group of users.
6. Design methods for controlling privileges for groups of users.
7. Design methods for the control restriction and extensions of single-user privileges
8. Design method for overall system privilege.

practical teaching

The practical part of the subject directly follow lectures. Discusses the design of several system privileges. For each considered system of privileges defined appropriate tables and their relationships. Depending on the case study system privilege is adapted for use.

prerequisite

The basic course of SQL.

learning resources

All that is necessary is to be found on the Internet and is under the GPL.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 0; calculation tasks: 0; seminar works: 45; project design: 0; final exam: 50; requirements to take the exam (number of points): 50

references

Selected Chapters in Fluid Mechanics

ID: PhD-3308
teaching professor: Čantrak M. Svetislav
ECTS credits: 5

goals

learning outcomes

theoretical teaching

Physical and mathematical fundamentals, methods and phenomena in fluid mechanics. General laws of conservation of mass, momentum and energy in integral and differential forms. Constitutive equations and laws of rheological material behavior. Cauchy and Navier-Stokes equations. Hydrodynamic stability of turbulence. Reynolds equations. Fundamental laminar and turbulent internal and external flow. The physical basis of the theory of stratified and rotating fluids. Physical and mathematical models of unsteady convective and MHD flow. Introduction to multiphase flow systems and non-newtonian flow. Interaction of fluids (Newtonian, viscoelastic,viscoplastic, thermoviscoelastic and others) and solids (structure). Basic mathematical and experimental methods in fluid mechanics.

practical teaching

prerequisite

learning resources

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Tritton, D.J.: Physical Fluid Dynamics, Van Nostrand Reinhold Company, New York, 1977.
Tennekes, H., Lumley, J.L.: A First Course in Turbulence, The MIT Press, Cambridge, 1978.
Čantrak, S.: Hydrodynamics, Fac. of Mech. Eng., Belgrade, 2000 (in Serbian).
Hinze, J.D.: Turbulence, McGraw - Hill, New York , 1975.
Panton, R. L.: Incompressible Flow, John Wiley & Sons, New York, 1984.

Selected chapters of mechanics

ID: PhD-3170
teaching professor: Mitrović S. Zoran
ECTS credits: 5

goals

The goal of this course is that students learn the basic elements: analytical mechanics, dynamics of rigid bodies system, stability of mechanical systems, oscillation of mechanical systems, optimal control theory.

learning outcomes

By gaining knowledge in this course, students will be able to carry out research in the fields of mechanical engineering, where there are problems of mechanics of rigid bodies. Students will be able to solve the basic problems of analytical mechanics, dynamics of rigid bodies system, stability of mechanical systems ...

theoretical teaching

General principles of mechanics. Lagrange principle. Dalamber-Lagrange principle Lagrange's equations of the second kind (covariant and contravariant form). Analysis of Lagrange's equations. Hamilton's principle. The canonical equations. The dynamics of a system of rigid bodies. The stability condition of the mechanical system. Fundamentals of linear oscillations of mechanical systems. Control. Permissive control. Optimal control. Optimality.

practical teaching

prerequisite

Defined by the curriculum study of PhD studies program.

learning resources

Vuković J., Selected chapters of mechanics, Handouts, Faculty of mechanical engineering, Belgrade 2006.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

Gantmaher F.R., Analytical mechanics, (in Russian), Zavod za izdavanje udžbenika SRS, Belgrade 1963.
Pontrjagin L.S., Mathematical theory of optimal control, (in Russian), Fizmatgiz, Moscow 1961.
Leitmann G., An Introducyion to Optimal Control, McGraw-Hill Book Company, 1966.
Rao S.S.: Mechanical vibrations, Addison-Wesley Publishing Company Inc., 1995.
Bakša A.,Vesković M., Stability of a motion (in Serbian), Faculty of Mathematics, Belgrade, 1996.

Selected chapters of mechanics of robots

ID: PhD-3119
teaching professor: Lazarević P. Mihailo
ECTS credits: 5

goals

Introduce students to basic concepts of kinematics and dynamics of robotic systems. It is possible to solve direct and inverse kinematics and dynamics of the robot system (RS) using modern theory based on Rodriguez transformation matrix,quaternions as well as the theory of finite rotations. Determination (simulation) models of RS - i.e. differential equations of motion of the RS, which are important in practical problems of the RS.Practical simulations RS using MATLAB, Cyberbotics Webots software package and students work with laboratory robot NEUROARM.

learning outcomes

By attending this course student acquires the ability to analyze problems and synthesis solutions to the problem of kinematics and dynamics of robotic systems using scientific methods and procedures as well as computer technology and equipment. This enabled him applying solutions to practical problems of robotic systems as well as monitoring and implementation of innovation in the development of new robotic systems.

theoretical teaching

Basic concepts of robotic system (RS). Orthogonal transformation of coordinates.Rodriguez formula and the transformation matrix (MT,complex MT of coordinates. Quaternions.Position vectors that define the configuration of the RS, internal and external coordinates of RS. Kinematics of RS:velocity and acceleration of the center of inertia of an arbitrary robot segment(RSE). Angular velocity and angular acceleration of an arbitrary RSE,velocity of gripper tip of RS. Direct and inverse kinematics of robot task. Constraints of RS. Momentum, angular momentum, kinetic energy of arbitrary robot segment of RS. Kinetic energy and the metric tensor of RS. Generalized forces and the principle of ideality RS-different cases. Differential equations (DIFE)of motion of RS. Other methods of forming (DIFE) of motion of RS. DIFE of motion of RS given in the form of kinematic chain with the structure of topological three and in the form of closed-kinematic chain. Additional equations of contraints. Constrained motion of robotic gripper. Equations of motion of RS with Langrange multipliers. Redundant RS. Basic concepts of control RS.

practical teaching

Examples of determining the number of degrees of motion of the RS; Calculation the transformation matrix(MT)- in case of Euler angles, and Hamilton-Rodriguez parameters;quaternions. Determination of kinematic characteristics of the robot segment (RSE): angular velocity and angular acceleration RSE, velocity and acceleration of the observed point-RSE cases of Rezales and Euler angles.Application of Rodriguez transformation matrix, determine position vectors which define the configuration of the RS-in MATLAB environment. Kinematic characteristics of the i-th robot segment. Solving the direct and inverse kinematic task of RS. Determination of (planar) inertia tensor RSE, RS. Obtaining momentum and angular momentum, kinetic energy, the coefficient of the metric tensor RS, generalized forces, Christoffel symbols of the first kind. Solving the direct and inverse dynamics task of the RS. Examples of DIFE of RS simulation in MATLAB-GUI, MATHEMATICA environment, an example of a redundant RS. An example of simulation RS using Cyberbotics Webots package. Example of control of the RS-laboratory robot NeuroArm with 7 degrees of freedom in the

MATLAB environment.

prerequisite

none

learning resources

1.Čović M. V. Lazarević, Mechanics of Robot, MF Belgrade,2009.(Book)
2.Lazarević M. Exercises in mechanics of robot, MF Belgrade,2006.(ZZD)
3.Wittenburg J., Dynamics of Systems of Rigid Bodies, Teubner, Stuttgart, 1977. (XJ)
4.Craig J., Introduction to Robotics, Mechanics and Control, Addison-Wesley, 1989.
5.Written abstracts from the lectures (Handouts)
6.Cyberbotics Webots - software package
7.NeuroArm-laboratory robot with 7 degrees of freedom.
8.MATLAB,MATHEMATICA-mathematics software packages
9.Kuipers, J.B.: Quaternions and Rotation Sequences: A Primer with Applications to Orbits,Aerospace and Virtual Reality, PrincetonUniversity Press, New Jersey, 1999.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

Bruno Siciliano, Oussama Khatib, Springer Handbook of Robotics,Springer-Verlag Berlin Heidelberg 2008.
Thomas R. Kurfess.,Robotics and automation handbook,CRC Press LLC, Boca Raton, Florida,2005
Ahmed A. Shabana, Dynamics of Multibody Systems,Cambridge University Press The Edinburgh Building, Cambridge , UK,2005.
M.W. Spong, M. Vidyasagar: Robot Dynamics and Control (Wiley, New York 1989)
R. Paul: Robot Manipulators: Mathematics, Programming and Control (MIT Press, Cambridge 1982)

Selected topics from propulsion

ID: PhD-3295
teaching professor: Fotev G. Vasko
ECTS credits: 5

goals

Introduction of students with real overall engine, and engine energetic elements, real performances.

learning outcomes

Student who is capable to deal with performances of real propulsor, or some of its energetic elements, like:
intake
compressor – fan
main Combustor – reheat combustor
turbine
nozzle.

theoretical teaching

Education starts with introduction into the calculation methods for real engine performances. After that it follows the student, chosen chapters (owe all propulsor or its main energetic elements).

practical teaching

Performances of real propulsor.
Performances of real intake.
Performances of real compressor - fan.
Performances of real primary combustor and afterburner.
Performances of real turbine.
Performances of real nozzle.

prerequisite

Msc. aerospace.

learning resources

CFD FLUENT, Payton.

number of hours

lectures: 35
research: 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: 70; project design: 0; final exam: 30; requirements to take the exam (number of points): 35

references

Ronald D. Flack, «Fundamentals of Jet Propulsion with Applications», Cambrdge University Press 2005
Jack D. Mattigly, »Aircraft Engine Design«, AIAA edu. series, N. Y. 1987.
J. H. Horlock, «Axial flow turbines», Robert E. Krieger publishing CO., Florida 1985.
S. L. Dixon, «Fluid Mechanics, Thermodynamics of Turbomachinery», Pergamon Press 1981
W. H. Heiser, D. T. Pratt, «Hypersonic Airbreahing Propulsion», AIAA edu. series, Washington, DC. 1994.

Selected topics in aerodynamics

ID: PhD-3231
teaching professor: Rašuo P. Boško
ECTS credits: 5

goals

Introducing students to selected topics of theoretical and experimental aerodynamic in hyposonic, subsonic, transonic, supersonic and hipersonic speed area.

learning outcomes

Students will be introduced to the procedure of abstract thinking and creative idea generation, the methodology of the design and development of new aircraft and spacecraft on the most advanced technological solutions.

theoretical teaching

The characteristics in the subsonic, transonic, supersonic and hipersonic wind tunnel testing. Calculation methods in aerodynamics, Selected topics from the boundary layer theory and turbulent flow. The characteristics of flow at low Reynolds numbers.

practical teaching

Modeling and Simulation of flow with MATLAB, FLUENT etc. Simulation aerodynamic parameters in wind tunnels.

prerequisite

No special conditions

learning resources

Books: Rašuo, B., Two-dimensional Transonic Wind Tunnel Wall Interference, Monographical Booklets in Applied & Computer Mathematics, MB-28/PAMM, Technical University of Budapest, Budapest, 2003, Griebel M., Dornsheifer T., and Neunhoeffer T., Numerical Simulation in Fluid Dynamics, Society for Industrial and Applied Mathematics, 1997, S.B.Pope, Turbulent Flows, Cambridge Univ Pr, 2000, Alexander J. Smits, Jean-Paul Dussauge, Turbulent Shear Layers in Supersonic Flow, 2nd Edition, Springer Verlag, 2005,Herrmann Schlichting, Klaus Gersten, Boundary-Layer Theory, Springer Verlag, 1999, 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

lectures: 35
research: 0

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): 40

references

Rašuo, B., Two-dimensional Transonic Wind Tunnel Wall Interference, Monographical Booklets in Applied & Computer Mathematics, MB-28/PAMM, Technical University of Budapest, Budapest, 2003
Griebel M., Dornsheifer T., and Neunhoeffer T., Numerical Simulation in Fluid Dynamics, Society for Industrial and Applied Mathematics, 1997
S. B. Pope, Turbulent Flows, Cambridge Univ Pr, 2000
Alexander J. Smits, Jean-Paul Dussauge, Turbulent Shear Layers in Supersonic Flow, 2nd Edition, Springer Verlag, 2005
Herrmann Schlichting, Klaus Gersten, Boundary-Layer Theory, Springer Verlag, 1999

Selected topics in aeroelasticity

ID: PhD-3053
teaching professor: Dinulović R. Mirko
ECTS credits: 5

goals

1. Introducing students to the problems and modern methods of calculation and analysis of complex aeroelastic events, and their application in solving practical problems.
2.Introduce students to the methods of experimental investigation of dynamics of aircraft structures.
3.Introducing students to the phenomenon of fluid structure interaction.

learning outcomes

1. mastering theoretical knowledge related to aeroleasticty
2. application of theoretical knowledge to solve aeroelasticity problems on real aircraft structures and structures in general.

theoretical teaching

1. Overview of Aeroelastic phenomena in mechanical, civil and aerospace engineering
2. Static aeroelastic phenomena
3. Dynamic aeroelastic phenomena
4. Section method, torsional divergence of lifting surfaces
5. Flutter, flutter types
6. Numerical methods for static aeroelasticity problems
7. Numerical methods for dynamic aeoelasticity problems
8. Application of La Place transformations in solving aeroelasticity problems

practical teaching

1. Prctical modeling of real lifting surfaces
2. Strucure response analysis, analysis of aeroelastict occurences (torsional divergence and flutter)

prerequisite

Numerical methods, Theory of elasticity, Structural Analysis

learning resources

Laboratory for Theory of elasticity and Aeroelasticity

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

An introduction to the theory of Aeroelasticity, Y.C. Fung, Dover press, 2nd edition
Principles of Aeroelasticity, Raymond Bisplinghoff, Holt Ashley, Dover Press
Aeroelasticity of Plates and Shells, E. H. Dowell
Studies in Nonlinear Aeroelasticity, Earl H. Dowell , Marat Ilgamov
Theoretical and Computational Aeroelasticity, William P Rodden

Selected Topics in Aircraft Armament Systems

ID: PhD-3280
teaching professor: Stupar N. Slobodan
ECTS credits: 5

goals

The study of this course is to ensure adoption of advanced procedures and methods for problem solving related to aircraft armament. The course aim is to enable students for analysis and calculations of fire, rocket, bomber, mine and torpedo aircraft armament elements in order to obtain the best possible performance of airborne platforms and maximal action efficiency at specific application conditions of each of these types of armament. Analysis and calculation of these elements of aircraft weapons will precede the study of gunpowder and explosives as its integral parts.
Students will also through course get better knowledge to the principles and functioning of the guidance and control of aircraft ordnance. Specially will be taken to the historical development of aircraft armament, and trends in the development of modern aircraft armament.

learning outcomes

Student will obtain, through these programs, following advanced subject - specific skills:

- fundamental knowledge and understanding of gunpowder and explosives
- fundamental knowledge and understanding of different types of armaments and their application
- fundamental knowledge and understanding of guidance and control of aircraft ordnance
- calculation and analysis of aircraft weapons characteristics and their integration on aircraft trough modern scientific methods and procedures

This course provides basic knowledge connectivity of mathematics, programming, mechanics, aerodynamics, flight dynamics and structures structural mechanics and their application to the design and calculation of aircraft armament and its integration.
Student will obtain, through these programs, following advanced subject - specific skills:

- fundamental knowledge and understanding of gunpowder and explosives
- fundamental knowledge and understanding of different types of armaments and their application
- fundamental knowledge and understanding of guidance and control of aircraft ordnance
- calculation and analysis of aircraft weapons characteristics and their integration on aircraft trough modern scientific methods and procedures

This course provides basic knowledge connectivity of mathematics, programming, mechanics, aerodynamics, flight dynamics and structures structural mechanics and their application to the design and calculation of aircraft armament and its integration.

theoretical teaching

Introduction to the field of aircraft armament and its historical development
Division and classification of aircraft armament
Development trends of aircraft armament
Introduction to the field of gunpowder and explosives and its historical development
Division and classification of gunpowder and explosives
Research of gunpowder and explosives characteristics
Aircraft firearm armament

Aircraft missile armament
Aircraft bomber armament
Guidance and control

practical teaching

Division and classification of aircraft armament with practical examples
Division and classification of gunpowder and explosives with practical examples
Calculations of gunpowder and explosives
Division and classification of aircraft firearm armament with practical examples
Calculations and analysis of aircraft firearm armament
Division and classification of aircraft missile armament with practical examples
Calculations and analysis of aircraft missile armament
Division and classification of aircraft bomber armament with practical examples
Calculations and analysis aircraft bomber armament
Analysis of guidance and control system and methods with practical examples

prerequisite

There is no necessary requirement for attendance of Selected Topics in Aircraft Armament Systems.

learning resources

Simlab - computer laboratory

number of hours

lectures: 35
research: 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

Jankovic S. Aerodinamika projektila, Faculty of Mechanical Engineering, Belgrade, 1979
Selected research articles and conference papers.
Additional materials (written handouts, problem setting, guidelines for problem solving)

Selected topics in composite structures

ID: PhD-3232
teaching professor: Rašuo P. Boško
ECTS credits: 5

goals

Introduce students to modern production technologies, calculation and testing of aircraft structures that are made of composite materials.

learning outcomes

Students will be introduced to the procedure of abstract thinking and creative idea generation, the methodology of the design and development of new composite constructions on the most advanced technological solutions.

theoretical teaching

Modern composite materials. Thermoplastic and thermoset materials in aviation. Synthetic resins - matrix (binder) materials: epoxy, polyester, vinyl ester-, phenolic, polyimide, etc. bizmaleimidne. Armirajuća fibers: glass, carbon, aramid and pine (Kevlar). Prepreg materials. Modern hybrreinforced. Reinforced materials. Composites based metal matrix. Modern ceramic materials. Mechanics of composite materials. Elastic properties of composite materials, analysis of the stress state in the structure of bonded joints of composite materials. Stress-strain conditions at the free edges of the laminate.

practical teaching

Verification, homologation and fatigue testing of aircraft composite structures that are performинг at the Laboratory Institute of Aeronautical Department, Faculty of Mechanical Engineering, the University of Belgrade.

prerequisite

No special conditions

learning resources

Books: A. A. Baker, Donald Kelly, Stuart Dutton, Alan A. Baker, Composite Materials for Aircraft Structures, 2nd Edition, AIAA, 2004 and Valery V. Vasiliev and Evgeny V. Morozov, Advanced Mechanics of Composite Materials, Elsevier Ltd. 2007, 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.

Laboratory of Aeronautical Department, Faculty of Mechanical Engineering, the University of Belgrade for verification, homologation and fatigue testing of aircraft structures.

number of hours

lectures: 35
research: 0

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): 40

references

A. A. Baker, Donald Kelly, Stuart Dutton, Alan A. Baker, Composite Materials for Aircraft Structures, 2nd Edition, AIAA, 2004.
Valery V. Vasiliev and Evgeny V. Morozov, Advanced Mechanics of Composite Materials, Elsevier Ltd. 2007.

Selected Topics in Design and Construction - A

ID: PhD-3238
teaching professor: Ristivojević R. Mileta
ECTS credits: 5

goals

Acquisition of advanced knowledge ин elaborating alternative construction solutions and optimum choice from the techno-economic and environmental-energy aspects. Essential technical indicators are service life in the area of low-cycle and hi-cycle fatigue and reliability.

learning outcomes

Students will be able to: use the scientific literature on selected areas from the scope of the Course; independently solve a scientific-research problems from selected area (making of appropriate analytical, numerical and experimental models); individually or as a team member, to write scientific research papers; to transfer knowledge and skills to others.

theoretical teaching

Stages in the process of designing and constructing. Definition of executors for basic, partial and general functions. The formation of variant solutions and their evaluation - techno economic criteria. Selection of a compromise solution. The variant constructions. The product life cycle. Unification and typization. Measuring chains. The rules and regulations in the design process and constructing. Introduction to basic concepts and regulations related to construction processes in mechanical engineering. The necessity of compliance with regulations. Conformity Assessment. Harmonized standards. CE marking of products. Placing products on the market. Pressure vessels. Thick and thin walls pressure vessels. Operational stresses. Thermal strain. Critical stresses in static conditions. Selection of welded joints in terms of mutual position of parts to be joined. Types of edges and butt welds (shapes and dimensions) and their application domain. The behavior of structures in the area of low cycle fatigue. The behavior of structures in the area of high cycle fatigue. Design and construction of welded structures. Lightweight constructions. Technologibility in the process of constructing.

practical teaching

Variant construction solutions. Construction of typizated parts. Executors of elementary and partial functions. Forming and calculation of measuring chains. Application of rules and regulations in the machinery design process. Essay. Calculation problem training in the field of Pressure vessels. Example of constructing in the area of low fatigue load. Dimension calculation of elementary functions executors. Determination of service life. Calculation of light structures. The essay about dimension calculation of elementary and partial functions executors. Designing from fabrication and assembly point of view.

prerequisite

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learning resources

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

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0; test/colloquium: 0; laboratory exercises: 30; calculation tasks: 15; seminar works: 30; project design: 0; final exam: 25; requirements to take the exam (number of points): 35

references

Ognjanović M.: Machine design, Faculty of Mechanical Engineering, Belgrade, 2000.
Karl-Heinz Decker: Machinenelemente: Funktion, Gestaltung und Berechnung, Hanser Verlag, 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

Selected Topics in Design and Construction - B

ID: PhD-3174
teaching professor: Mitrović M. Radivoje
ECTS credits: 5

goals

Acquisition of advanced knowledge ин elaborating alternative construction solutions and optimum choice from the techno-economic and environmental-energy aspects. Essential technical indicators are service life in the area of low-cycle and hi-cycle fatigue and reliability.

learning outcomes

Students will be able to: use the scientific literature on selected areas from the scope of the Course; independently solve a scientific-research problems from selected area (making of appropriate analytical, numerical and experimental models); individually or as a team member, to write scientific research papers; to transfer knowledge and skills to others.

theoretical teaching

Stages in the process of designing and constructing. Definition of executors for basic, partial and general functions. The formation of variant solutions and their evaluation - techno economic criteria. Selection of a compromise solution. The variant constructions. The product life cycle. Unification and typization. Measuring chains. The rules and regulations in the design process and constructing. Introduction to basic concepts and regulations related to construction processes in mechanical engineering. The necessity of compliance with regulations. Conformity Assessment. Harmonized standards. CE marking of products. Placing products on the market. Pressure vessels. Thick and thin walls pressure vessels. Operational stresses. Thermal strain. Critical stresses in static conditions. Selection of welded joints in terms of mutual position of parts to be joined. Types of edges and butt welds (shapes and dimensions) and their application domain. The behavior of structures in the area of low cycle fatigue. The behavior of structures in the area of high cycle fatigue. Design and construction of welded structures. Lightweight constructions. Technologibility in the process of constructing.

practical teaching

Variant construction solutions. Construction of typizated parts. Executors of elementary and partial functions. Forming and calculation of measuring chains. Application of rules and regulations in the machinery design process. Essay. Calculation problem training in the field of Pressure vessels. Example of constructing in the area of low fatigue load. Dimension calculation of elementary functions executors. Determination of service life. Calculation of light structures. The essay about dimension calculation of elementary and partial functions executors. Designing from fabrication and assembly point of view.

prerequisite

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learning resources

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

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0; test/colloquium: 0; laboratory exercises: 30; calculation tasks: 15; seminar works: 30; project design: 0; final exam: 25; requirements to take the exam (number of points): 35

references

Ognjanović M.: Machine design, Faculty of Mechanical Engineering, Belgrade, 2000.
Karl-Heinz Decker: Machinenelemente: Funktion, Gestaltung und Berechnung, Hanser Verlag, 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

Selected Topics in Fluid Mechanics

ID: PhD-3331
teaching professor: Stefanović A. Zoran
ECTS credits: 5

goals

Course provides students with a lasting and solid understanding of fluid mechanics. Effectively teach fundamental concepts in fluid mechanics, including mass, energy and momentum balances. Teach students how to properly set up and solve fluid mechanics problems both analytically and numerically. Course material varies each academic year depending upon the focus of the design problems.

learning outcomes

Upon completion and passing the Course the student is expected to have independent research, collection the data, standard problem take into analytical the identification acquire conclusion, and have development innovation and compose the ability of professional thesis. Usage mathematics engineering realm is related analysis and design software, explanation data with independently solve the ability of problems.

theoretical teaching

2D irotational flow in rectangular and polar coordinates; Irrotationality and the velocity potential function; Voriticity and circulation; Potential flow and the complex potential function; Sources, sinks, doublets and vorities-Superposition of uniform stream with above; Flow around corners; Ranbkine ovals; Flow around circular cylinders with and without circulation; Pressure distribution on the surface of bodies and D'Alembert's paradox; Blasuis theorem for forces and moments; Method of residues, Conformal transformation of flows with solid boundaries. Elements of two-dimensional aerofoil theory; Joukowski transformation; Circular are symmetrical aerofoil theory; Joukowski hypothesis, Lift and moment.
3D Irotational Flow: Irrotationality and the velocity potential function; Symmetric flows and the Stokes stream function; Sources, sinks.
Vortex Motion: Definition; Vortex lines; Surfaces and tubes; Vorticity; Kelvin's circulation theorem; Helmholtz's vorticity theorems; Convection and diffusion of vorticity. Vortex filament, Biot-Savart law for induced velocities; Rectilinear vortex filaments; System of vortex filaments; Horseshoe vortex filaments; Ring vortices; Vortex sheets; Karman vortex sheet.
Viscous Flow: exact solution; Plane Poiselle and Courtte flows; Hagen-Piselle flow through pipes.

practical teaching

Practical part of course demonstrate the numerical examples in variety of areas of fluid mechanics. Practical work of students is realized through a virtual classroom available 24 hours (program MOODLE). In the workshop students have approach to the professor's written notes, lectures and tests for practice. Each student works and study problems individually.

prerequisite

none

learning resources

This course is open a virtual classroom on the Internet. At the first lecture students are enrolled and trained for work (Moodle software). In the workshop approach is performed with the lectures and exercises, guidelines for project design, internet resources, quizzes , etc.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 15; test/colloquium: 20; laboratory exercises: 0; calculation tasks: 30; seminar works: 0; project design: 0; final exam: 35; requirements to take the exam (number of points): 30

references

Zoran Stefanović, Zlatko Petrović . Handouts for Selected Topics in Fluid Mechanics, Faculty of Mechanical Engineering, 2012.
William Graebel: Advanced Fluid Mechanics, Academic Press, 2007
Y.Cengel, J.Cimbala: Fluid Mechanics, McGraw Hill, 2006

Selected topics in fluid structure interaction

ID: PhD-3256
teaching professor: Simonović M. Aleksandar
ECTS credits: 5

goals

Study of theoretical backgrounds and applying of contemporary research methods related to fluid-structure interaction. Development of creative abilities for R&D and specific engineering problems approach using advanced fluid-structures analysis methods.

learning outcomes

Vast and comprehensive field of fluid-structural interaction is covered with contemporary approach methods. Advanced methods of fluid-structure interaction analysis included, enable extended analysis and solving of different types of problems in this field.

theoretical teaching

Comply with the subject of the research of the candidate's doctoral thesis

practical teaching

prerequisite

learning resources

number of hours

lectures: 35
research: 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

Y.Bazilevs, K.Takizawa, T.Tezduyar, COMPUTATIONAL FLUID STRUCTURE INTERACTION-METHODS AND APPLICATIONS, Wiley, 2013
G.Galdi, R.Rannacher, FUNDAMENTAL TRENDS IN FLUID STRUCTURE INTERACTION, World Scientific, 2010
M. Paidoussis, S.Price, E. de Langre, FLUID STRUCTURE INTERACTIONS-CROSS-FLOW-INDUCED INSTABILITIES, cambridge, 2010
H.-J. Bungartz, M. Schafer, FLUID-STRUCTURE INTERACTION II, MODELLING, SIMULATION, OPTIMIZATION, SPRINGER,2010
H.-J. Bungartz, M. Schafer, FLUID-STRUCTURE INTERACTION, MODELLING, SIMULATION, OPTIMIZATION, SPRINGER,2006

Selected Topics in Machine Elements - A

ID: PhD-3175
teaching professor: Mitrović M. Radivoje
ECTS credits: 5

goals

Studying the behavior of machine parts and components, in general and standard ones in operational and critical conditions, from the surface and volumetric strength, stiffness, operational life stability and energy efficiency point of view. Determination the load essential for the analysis of the operational capacity of machine elements and components,based on analytical, numerical and experimental methods.

learning outcomes

Students will be able to: use the scientific literature on selected areas from the scope of the Course; independently solve a scientific-research problems from selected area (making of appropriate analytical, numerical and experimental models); individually or as a team member, to write scientific research papers; to transfer knowledge and skills to others.

theoretical teaching

Tolerances and fittings. Behavioral problems of machine elements in static and dynamic operational mode. Axles and shafts. Universal (Cardan) joints. Sliding and rolling bearings. Threaded joints. Power transmitions (frictional, gear, belt, chain) - calculation and simulation. Threaded transmition. Couplings. Springs. Inseparable joints.

practical teaching

prerequisite

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learning resources

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

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Ognjanović M.: Machine elements, Faculty of Mechanical Engineering, Belgrade, 2011.
Karl-Heinz Decker: Machinenelemente: Funktion, Gestaltung und Berechnung, Hanser Verlag, 2000
Orlov P.: Fundamentals of Machine Design, MIR Publishers - Moscow, 1980.
S.Veriga: Machine elements 1, Faculty of Mechanical Engineering, Belgrade
Z.Stamenic, PhD thesis (area: Cardan shafts), Faculty of Mechanical Engineering, Belgrade, 2012.

Selected Topics in Machine Elements - B

ID: PhD-3239
teaching professor: Ristivojević R. Mileta
ECTS credits: 5

goals

Studying the behavior of machine parts and components, in general and standard ones in operational and critical conditions, from the surface and volumetric strength, stiffness, operational life stability and energy efficiency point of view. Determination the load essential for the analysis of the operational capacity of machine elements and components,based on analytical, numerical and experimental methods.

learning outcomes

Students will be able to: use the scientific literature on selected areas from the scope of the Course; independently solve a scientific-research problems from selected area (making of appropriate analytical, numerical and experimental models); individually or as a team member, to write scientific research papers; to transfer knowledge and skills to others.

theoretical teaching

Tolerances and fittings. Behavioral problems of machine elements in static and dynamic operational mode. Axles and shafts. Universal (Cardan) joints. Sliding and rolling bearings. Threaded joints. Power transmissions (frictional, gear, belt, chain) - calculation and simulation. Threaded transmission. Couplings. Springs. Inseparable joints.

practical teaching

prerequisite

-

learning resources

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

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Ognjanović M.: Machine elements, Faculty of Mechanical Engineering, Belgrade, 2011.
Karl-Heinz Decker: Machinenelemente: Funktion, Gestaltung und Berechnung, Hanser Verlag, 2000
Orlov P.: Fundamentals of Machine Design, MIR Publishers - Moscow, 1980.
S.Veriga: Machine elements 1, Faculty of Mechanical Engineering, Belgrade
Z.Stamenic, PhD thesis (area: Cardan shafts), Faculty of Mechanical Engineering, Belgrade, 2012.

Selected topics in Machine elements V

ID: PhD-3131
teaching professor: Lazović M. Tatjana
ECTS credits: 5

goals

Demonstrate knowledge and understanding in the field of machine elements research, based on the current specialist knowledge, a general knowledge of research methodology, as well as the specific methods of chosen research field (particular machine element or group of elements). Research in the Machine element field implies an analysis of their operational ability in terms of all relevant influences of: geometry, mechanical properties of materials, operational conditions and environment (load, speed, frequency, temperature, lubrication ...), friction and wear, maintenance, and reliability.

learning outcomes

At the end of the course, in the field of Machine elements research, student should be able to:
- identify and formulate questions autonomously and creatively, with scholarly precision, critically, to select and apply appropriate methods, to undertake a limited part of the research and other professional activities with predetermined time frames, as well as to critically assess the expected results;
- to present and discuss research results;
- demonstrate the skills needed to participate autonomously in research and development work.

theoretical teaching

Review and recap of knowledge obtained in the field of mechanical elements, as well as review and showing the importance of scientific disciplines that are basis of the study of machine elements. The operational ability of machine elements and all relevant influences. Geometry (shape and size) of machine elements. Materials of machine elements (mechanical properties). Load of machine elements. Load carrying capacity of machine elements. Load distribution in different machine elements (phenomena description and distribution parameters). Vibration and noise of machine elements. Types of damage and failure analysis of machine elements Tribology of machine elements (lubrication, friction and wear). Reliability and service life of machine elements. Condition monitoring and maintenance of machine elements.

practical teaching

Introduction to the analytical, numerical and experimental methods of machine elements research. Introduction to the various forms of machine elements laboratory testing (review and description of methods, devices and means of measurement and data acquisition). Laboratory exercises in the field of selected topic in machine elements investigation. Consultation in the preparation of the seminar work.

prerequisite

No special condition.

learning resources

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

number of hours

lectures: 35
research: 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: 80; project design: 0; final exam: 20; requirements to take the exam (number of points): 50

references

Ognjanović M.: Mašinski elementi, Mašinski fakultet Beograd
Veriga S.: Mašinski elementi (I, II, III), Mašinski fakultet Beograd
Mitrović R.: Klizni i kotrljajni ležaji, Mašinski fakultet Beograd
Ristivojević M., Mitrović R.: Raspodela opterećenja - Zupčasti parovi i kotrljajni ležaji, Mašinski fakultet Beograd
Appropriate literature, available at lecturer office

Selected topics in material handling, constructions and logistics

ID: PhD-3021
teaching professor: Bošnjak M. Srđan
ECTS credits: 5

goals

Basic course goal: mastering practical skills which are necessary for solving the specific problems in fields of Material handling, Construction and Logistics (MHCL)

learning outcomes

Mastering the curriculum student gains: 1) general skills which can be used in in fields of MHCL (analysis, synthesis and anticipation of solution and consequences; development of critical approach) 2) specific skills (use of gained knowledge on solving the problems in fields of MHCL)

theoretical teaching

Selected topics in MHCL according to the candidate's preferences.

practical teaching

Selected topics in MHCL according to the candidate's preferences.

prerequisite

Courses: Structural Analysis of Material Handling Mach., Dyn.and Str. of Min. and Construc. Mach., Dynamics of Material Handling and Conveying Mach.

learning resources

1. Computers, Laboratory 516
2. Software Matlab, Catia

number of hours

lectures: 35
research: 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

Selected according to the candidate's preferences

Selected Topics in Operations Research

ID: PhD-3345
teaching professor: Bugarić S. Uglješa
ECTS credits: 5

goals

An operations researcher faced with a new problem is expected to determine which techniques are most appropriate given the nature of the system, the goals for improvement, and constraints on time and computing power. For this and other reasons, the human element of OR is vital. Therefore, course goal is overwhelm with advanced scientific methods and techniques for obtaining alternative solutions of real world problems on which basis optimal analysis and synthesis of obtained solutions can perform in order to make decisions and predict consequences.

learning outcomes

Like any other tools, OR techniques cannot solve problems by themselves. So, outcome is to qualify researcher to solve concrete problems with application of specific advanced scientific methods, procedures and techniques using analysis, synthesis and prediction of solutions and consequences as well as to apply gained knowledge and skills in practice.

theoretical teaching

Topics for advanced research can be chosen (but not necessary) from following areas:
Applied Probability and Statistics, Simulation, Stochastic Processes, Queuing Theory, Game Theory, Graph Theory, Inventory Planning, Decision analysis and Forecasting, Mathematical Programming, Mathematical Modelling of Operational Systems, Project management, and other areas connected with candidate research.

practical teaching

Practical part of the course is restricted to laboratory work i.e. use of existing software or writing adequate one.

prerequisite

Students should have (but not necessary) a background in statistics, system engineering, mathematics, computer science.

learning resources

1. Bugaric, U., Petrovic, D.: Servicing system modelling, Faculty of Mechanical engineering Belgrade, Belgrade, 2011.
2. Bugaric, U.: Methodology for analysis of single position machines work, Foundation Andrejevic, Belgrade, 2003.
3. Software: QtsPlus 3.0 (Queuing theory software Plus).
4. Software: QSopt Version 1.0 (Linear programming problems).
5. Software: IOR Tutorial (Interactive Operations Research).
6. Software: MS – Project (Project management).
7. Personal computers.

number of hours

lectures: 35

research: 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: 0; project design: 0; final exam: 100; requirements to take the exam (number of points): 0

references

Petrić, J.: Operations Research (book 1 & 2), Savremena administracija, Belgrade, 1990.
Žiljak, V.: Computer simulation, Školska knjiga, Zagreb, 1982.
Clymer, J. R.: Systems analysis using simulation and Markov models, Prentice-Hall International Inc., 1990.
Churchman, C. W., Ackoff, R. L., Arnoff, E. L.: Introduction to Operations research, John Willey & Sons Inc., 1957.
Hillier, F. S., Lieberman, G. J.: Introduction to operations research (seventh edition), McGraw-Hill, New York, 2000.

Selected Topics in Operations Research

ID: PhD-3023
teaching professor: Bugarić S. Uglješa
ECTS credits: 5

goals

An operations researcher faced with a new problem is expected to determine which techniques are most appropriate given the nature of the system, the goals for improvement, and constraints on time and computing power. For this and other reasons, the human element of OR is vital. Therefore, course goal is overwhelm with advanced scientific methods and techniques for obtaining alternative solutions of real world problems on which basis optimal analysis and synthesis of obtained solutions can perform in order to make decisions and predict consequences.

learning outcomes

Like any other tools, OR techniques cannot solve problems by themselves. So, outcome is to qualify researcher to solve concrete problems with application of specific advanced scientific methods, procedures and techniques using analysis, synthesis and prediction of solutions and consequences as well as to apply gained knowledge and skills in practice.

theoretical teaching

Topics for advanced research can be chosen (but not necessary) from following areas: Applied Probability and Statistics, Simulation, Stochastic Processes, Queuing Theory, Game Theory, Graph Theory, Inventory Planning, Decision analysis and Forecasting, Mathematical Programming, Mathematical Modelling of Operational Systems, Project management, and other areas connected with candidate research.

practical teaching

Practical part of the course is restricted to laboratory work i.e. use of existing software or writing adequate one.

prerequisite

Students should have (but not necessary) a background in statistics, system engineering, mathematics, computer science.

learning resources

1. Bugaric, U., Petrovic, D.: Servicing system modelling, Faculty of Mechanical engineering Belgrade, Belgrade, 2011.
2. Bugaric, U.: Methodology for analysis of single position machines work, Foundation Andrejevic, Belgrade, 2003.
3. Software: QtsPlus 3.0 (Queuing theory software Plus).
4. Software: QSopt Version 1.0 (Linear programming problems).
5. Software: IOR Tutorial (Interactive Operations Research).
6. Software: MS – Project (Project management).
7. Personal computers.

number of hours

lectures: 35

research: 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: 0; project design: 0; final exam: 100; requirements to take the exam (number of points): 0

references

Petrić, J.: Operations Research (book 1 & 2), Savremena administracija, Belgrade, 1990.
Žiljak, V.: Computer simulation, Školska knjiga, Zagreb, 1982.
Clymer, J. R.: Systems analysis using simulation and Markov models, Prentice-Hall International Inc., 1990.
Churchman, C. W., Ackoff, R. L., Arnoff, E. L.: Introduction to Operations research, John Willey & Sons Inc., 1957.
Hillier, F. S., Lieberman, G. J.: Introduction to operations research (seventh edition), McGraw-Hill, New York, 2000.

Selected Topics in Programming Tools

ID: PhD-3373
teaching professor: Ristanović R. Milan
ECTS credits: 5

goals

• Learning basic MATLAB commands.
• Mastery of basic knowledge about the software package MATLAB and its applications in scientific research.
• Mastering advanced techniques of MATLAB.

learning outcomes

• Acquisition of basic knowledge of MATLAB.
• Иdentify and use the methods necessary for scientific research using MATLAB software package.
• MATLAB code optimization.

theoretical teaching

Introduction. Ways to use Matlab. Creating variable names. Management of variables. Accessing scripts and function files. Command window management. Online help. Basic Matlab syntax. Some suggestions on how to use Matlab. Matrices and vectors. Creation of vectors. Creation of matrices. Dot operation. Manipulation with matrices. Mathematical operation with matrices. Strings and annotated output. Entering data. Operation with strings. Input/output data files. Naming functions. Debugging functions. The function file. Inline function. Functions of functions - feval. Matlab functions that use feval: zeros of functions, numerical integration, local minimum of function. Numerical solution of ordinary differential equations. Numerical solutions of nonlinear equations. Examples of several Matlab functions: fitting data with polynomials, interpolation of data, fitting data with spline. 2D plotting commands. Graph annotations and visual Enhancement. Lines in 3D. Surfaces. Working with Simulink. Simulink libraries. Creating models in Simulink. S-functions.

practical teaching

Examples of material exposed to the following classes: writing a program in Matlab programming language, with emphasis on advanced techniques and code optimization. Examples of work in the computer lab, the experimental verification of programs written.

prerequisite

Defined by the Curriculum of modules.

learning resources

• Dragan V. Lazic, Milan R. Ristanovic, Introduction to Matlab, Faculty of Mechanical Engineering, 2nd edition, 2012.
• PCs, Computer laboratory, Faculty of Mechanical Engineering

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Magrab, B. Edward, "An Engineer's Guide to Matlab", Prentice Hall, Uper Saddle River, NJ 2000.
"Control Tutorials for Matlab", Carnegie Mellon, The University of Michi- gan, http://www.engin.umich.edu/group/ctm/ .

Selected Topics in Thermodynamics

ID: PhD-3332
teaching professor: Petrović V. Milan
ECTS credits: 5

goals

1. The achievement of research and expert competence in thermodynamic for in thermal power engineering.
2. The achievement of high level of theoretical knowledge
3. The acquisition of research and expert knowledge thermodynamic for in thermal power engineering.
4. The achievement of the techniques of process modeling.
5. Mastering the methods of experimental work in thermal power engineering.

learning outcomes

1. Expert and research deep knowledge of the thermodynamic cycle in thermal power engineering
2. The development of critical thinking about energy use, fuel efficiency and environmental preservation
3. Ability to use computer technology for modeling and calculations

theoretical teaching

Closed, Open and Isolated Systems. State, Equilibrium, Process and Properties, Thermodynamic Cycles. Energy, Energy Transfer. The First Law of Thermodynamics and General Energy Analysis. Energy Analysis of Closed Systems. Mass and Energy Analysis of Control Volumes. The Second Law of Thermodynamics. Entropy, Entropy Balance. Work Potential, Exergy and the Dead State. The Decrease of Exergy Principle and Exergy Destruction. Exergy Balances. Gas power cycles. Steam power cycles. Combined power cycles

practical teaching

Exercises.

prerequisite

PhD Student - Thermal power enegineering

learning resources

Literature, computing facility

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

M. Moran, H. Shapiro: Fundamentals of Engineering Thermodynamics, Wiley, 2007.
Y. A. Cengel and M. A. Boles: Thermodynamics: an Engineering Approach, McGraw Hill, 2006.
C. Borgnakke, R. Sonntag: Fundamentals of Engineering Thermodynamics, John Wiley & Sons, 2008.
H. D. Baehr, S. Kabelac: Thermodynamik: Grundlagen Und Technische Anwendungen
A. Bejan, Advanced Engineering Thermodynamics, 3rd ed., Wiley, 2006.

Selected topics in Wind Turbines

ID: PhD-3279
teaching professor: Stupar N. Slobodan
ECTS credits: 5

goals

The course covers in depth examination of topics selected by the instructor from among topics not covered in previous wind turbine design courses. The student will be introduced to advanced wind turbine design and control topics. The goal of this course is to expand student knowledge abut wind turbine design, and to explore current-day ideas and innovations in this field, also advances in wind turbine component design such as rotors, blades, drivetrain and generators are covered .

learning outcomes

Students will enrich and deepen their knowledge of contemporary issues in the field of design, development and operation of wind turbines.

theoretical teaching

Advanced optimization of wind turbine blades
Aerodynamics and design of Vertical Axis Wind Turbines
Smart blade concept - possibilities of smart materials usage in wind turbine design and control.
Reliability and cost of energy of advanced wind turbine concepts

practical teaching

Practical course follows the lecture content. During the course the student develops computer models and simulations to verify the advanced concepts vetroturbinskih system.

prerequisite

There is no necessary requirement for attendance of Selected topics in Wind Turbines.

learning resources

Simlab - computer laboratory

number of hours

lectures: 35
research: 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

Pesic S., Wind energy - Aerodynamics wind energy system with a horizontal axis rotor, Faculty of Mechanical Engineering, 1994.
Hau E., Wind turbines: Fundamentals, Technologies, Application, Economics, Springer 2006.
Selected research articles and conference papers
Additional materials (written performed with the lectures, setting tasks, guidelines for solving the task).

Selected topics of Heat and Mass transfer

ID: PhD-3105
teaching professor: Komatina S. Mirko
ECTS credits: 5

goals

Introduction to wide problematic of heat and mass transfer and current scientific problems. Mathematical methods in the field of heat and mass transfer. Theoretical basics of processes used in modern devices. Software tools.

learning outcomes

Students will master the problematic of heat and mass transfer. They will be able to apply their knowledge in complex research problems involving heat and mass transfer.

theoretical teaching

Vector and tensor analysis applied to heat and mass transfer. Theory of similarity and scale analysis. Combine heat transfer (application in water–humid air systems). Heat and mass transfer in fluidized bed. Heat transfer in porous materials with regard on porous cooling. Heat transfer in micro and nano systems. Heat pipes. Heating and cooling with thermoelectric modules.

practical teaching

prerequisite

learning resources

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 0

references

D. Kuzmanović, A. Sedmak, I. Obradović, D. Nikolić, RGF, Beograd, 2003
Andrian Bejan, Convection Heat Transfer, Wiley, 2004.
Andrian Bejan, Convection in Porous Media, Springer - Verlag, 1992.
. P. Holman, Heat Transfer, McGraw-Hill, 2002.
J.H. Lienhard IV and J.H. Lienhard V, A Heat Transfer Textbook, Phlogiston Press, 2003.

Selected topics of logistics

ID: PhD-3206
teaching professor: Petrović B. Dušan
ECTS credits: 5

goals

Achieving and improving competency and academic skills in the process of advance industrial system design. Special emphasis is focused on development and improvement of creative skills and overwhelm with specific practical skills needed for professional practice using selected post operational research methods, procedures of analysis and synthesis for obtaining final goal which is optimal practical solution.

learning outcomes

Post graduate curriculum overcome enables converge of the following skills: analysis, synthesis and prediction of solutions in design process of complex solution of design of logistic systems in industry based on knowledge applying in practice using professional ethics as well as development of crucial and self-critical thinking and approach.

theoretical teaching

Selected logistic system in industrial environment (role of logistic system in industry, functions which system must achieved and its benefit for industry). Elements of logistic system (production based on end user demand, distribution and warehouse systems). Selected basic sub-systems of logistic system (production with defined capacity, transport with defined technology and distribution warehouse system). Place and role of the warehouse in logistic system. Application and effects of application of logistic systems in industry (territory coverage with defining location of production and end user, reduction of transport and storage costs and increase of flexibility towards end user). Previous analysis needed for system design (general conditions for urban planning, logistic and transport connections, energetic and human potential). Design process procedure.

practical teaching

Audit design lessons (Design of selected processes for logistic system – defining elements of selected logistic system and basic sub-systems for chosen logistic system. Introduction in warehouse design of palletized goods – defining of: reception area, main warehouse, distribution – order picking, shipping and warehouse management system).
Project workmanship (Determining of the optimal location of the selected logistic system in macro surrounding – positioning of warehouse regarding to production and end user as a function of transport system. Project of warehouse for palletized goods - defining of: packing and capacity, work technology, layout, reception and shipping and warehouse management system).

prerequisite

There is no special conditions needed for course attending

learning resources

1. Petrovic, D.: 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. Zrnić, Đ., Petrović, D.: Factory design – assortment of solved examples, Faculty of Mechanical engineering Belgrade, Belgrade, 1990.
4. Zrnić, Đ., Petrović, D.: Stochastic process in transport, Faculty of Mechanical engineering Belgrade, Belgrade, 1994.
5. Bloomberg, D. J., LeMay, S. B., Hanna, J. B.: Logistics, Prentice Hall, New York, 2002.
6. Practical instruction in industrial environment.
7. Personal computers.

number of hours

lectures: 35
research: 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: 0; project design: 30; final exam: 70; requirements to take the exam (number of points): 0

references

Asimow, M.: Introduction to Design, Prentice-Hall, Englewood Cliffs, New Jersey, 1962.
Hall, A. D.: A methodology for systems engineering, Van Nostrand, Princeton, New Jersey, 1962.
Cooper, B. R.: Introduction to queueing theory (second edition), Elsevier North Holland, New York, 1981.

Selected Topics of Terminal Ballistics

ID: PhD-3068
teaching professor: Elek M. Predrag
ECTS credits: 5

goals

The aim of the course is to provide students with contemporary advanced knowledge in the field of terminal ballistics. The focus of the study are two key areas of terminal ballistics: penetration mechanics and blast effect. The main goal is to successfully use the methods of analytical modeling and numerical simulation of these phenomena.

learning outcomes

Students acquire contemporary knowledge about the mechanics of penetration and blast effect. The student can independently apply predictive analytic tools as well as advanced techniques of numerical simulation of the considered phenomena.

theoretical teaching

1. Penetration mechanics
Recapitulation of impact mechanics and shock wave physics. Characterization of the behavior of materials at high strain rates. Experimental methods of terminal ballistics. Analytical modeling of the dynamics of perforation of metal plates. Analytical models for soil, concrete and ceramics penetration. Eroding penetrators - penetration of long-rod projectiles and shaped charge jet. Numerical modeling of penetration.
2. Blast
The formation of the shock wave as a result of the explosion (blast). Modeling of a blast wave. Propagation and reflection of blast waves. Measurement techniques. Scaling blast parameters. Interaction of blast wave and the structure. Numerical simulation of the blast effect.

practical teaching

1. Penetration mechanics
Characterization of material behavior at high strain rates - examples of constitutive laws. Experimental methods of terminal ballistics - measurement techniques. Analytical modeling of metal plate penetration - analysis of different approaches. Analytical models for soil, concrete and ceramic penetration - the application. Eroding penetrators - application of the Tate-Aleksievski model. Numerical modeling of penetration using Abaqus software package.
2. Blast
The basic model of the blast wave - example. Propagation of blast waves in the air. Reflection of blast waves - the Mach wave. Examples of measurement techniques. Models for determination of blast wave parameters. Interaction of shock wave and structures - examples. Numerical simulation of blast effect using Abaqus software package.

prerequisite

learning resources

1. Zukas, J.A.: High velocity impact dynamics, John Wiley and Sons, 1990.
2. Needham, C.E.: Blast waves, Springer, 2010.
3. Carlucci, D.E., Jacobson, S.S.: Ballistics, CRC Press, 2007.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Rosenberg, Z., Dekel, E.: Terminal Ballistics, Springer, 2012.
Ben-Dor, G., Dubinsky,A., Eleperin, T.: Applied High-Speed Plate Penetration Dynamics, Springer, 2010.
Smith, P.D., Hetherington, J.G.: Blast and Ballistic Loadnig of Structures, Laxton's, 1994.

Selected topis in structural analysis of flying vehicles

ID: PhD-3054
teaching professor: Dinulović R. Mirko
ECTS credits: 5

goals

Mastering advanced structural analysis methods in metallic and composite sturctures for flying vehicles.

learning outcomes

1.Mastering of theoretical knowledge of structural analysis applied to aerospace structures.
2. Application of theoretical knowledge learned in solving practical problems.
3. Understanding of the structural scheme aircraft.
4. Understanding of modern methods for the design and analysis of aircraft structures.

theoretical teaching

1. Introduction
2. Tensor calculus
3. Force method
5. Aircraft as single elastic structure
6. Displacement method
7. Direct stiffness method
8. Nonlinearity in structural analysis

practical teaching

1. Real aircraft structures modeling an stress-strain field analysis
2. Metal and composite aircraft structure geometrical non linearity modelling

prerequisite

Structural analysis, Composite structures, Stuctural analysis of flying vehicles

learning resources

Laboratory for Theory of elasticity and Aeroelasticity.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Concepts and applications of finite element analysis, 3rd edition, Cook, Markus, Plesha
Advanced Structural Analysis,D. Menon
Advanced Methods of Structural Analysis , Igor A. Karnovsky , Olga Lebed

Selected Topics in Computational aerodynamics

ID: PhD-3281
teaching professor: Stupar N. Slobodan
ECTS credits: 5

goals

The course is linked to the subject taogut in the course Computational aerodynamics at previous study levels, but the material is conceived so that the object can be conceivable to the students who have not listened the course Computational aerodynamics. After a brief review of the basic theoretical equations governing the flow and analytical way of solving the problems of fluid dynamics, students are introduced to the basic and advanced methods of Computational aerodynamics. The course deals with the basics of panel methods, finite difference and finite volume methods. Through solving practical problems, student learns basic and advanced techniques of mesh generation, application of boundary and initial conditions and methods of calculation and visualization of results.

learning outcomes

Upon course completion, students gain practical and theoretical knowledge that will serve as a basis for further research and practical work in the field. By solving problems carefully selected by the teacher, the student will gain the necessary experience and will become able to independently determine the complexity of the problem, way of solving and predict potential problems that may arise in the development of the model, mesh generation and other steps in problem solving and to address these problems with adequate approaches. During the course, students will master the techniques of computer programming necessary to solve the problems of fluid dynamics as well as the technique of using existing software for the simulation in this area.

theoretical teaching

Brief introduction and derivation of the transport equation for fluid flow.
Presentation of selected problems solved by analytic methods.
Fundamentals of panel methods, finite difference and finite volume methods.
Basic and advanced techniques of mesh generation.
Demonstration of possible approaches to solution of viscous fluid flow.
The influence of compressibility and simulation of compressible fluid flow.
Simulation of turbulent flow.

practical teaching

Contents of exercises follows the exposed material. Students master the techniques of programming and use of existing software solutions in the area of computational aerodynamics. The examples and problems were selected so that the students are introduced to the problems that arise in the practical applications and trained in use of appropriate solving techniques.

prerequisite

There is no necessary requirement for attendance of Selected Topics in Computational aerodynamics.

learning resources

Simlab - computer laboratory

number of hours

lectures: 35
research: 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

Petrovic Z, Stupar S, CFD one, Faculty of Mechanical Engineering, 1992,
Ferziger J., Perić M., Computational Methods for Fluid Dynamics, Springer Verlag, 1999.
Selected research articles and conference papers.
Additional materials (lecture handouts, problem settings, problem solving guidelines)

Sliding and rolling bearings

ID: PhD-3173
teaching professor: Mitrović M. Radivoje
ECTS credits: 5

goals

The acquisition of advanced knowledge in the field of sliding and rolling bearings.

learning outcomes

Students gain the knowledge and skills: of bearing types and their application; to optimize bearing selection in the function of service conditions as well as its material; to properly select/construct a lubrication mechanisam and lubricant type.

theoretical teaching

Friction in sliding bearings and role of lubricants; Sliding bearing types; Introduction in lubrication hydrodynamics theory; Radial bearings with hydrodynamic lubrication; Bearings with hydrostatic lubrication; Sliding bearing materials; Rolling bearing types; Identification system; Tolerances and clearences; Bearing kinematic; Loads and stresses of bearing parts; Bearing capacity; Bearing selection; Lubricants; Lubrication and sealing; Bearing mounting; Articular bearings.

practical teaching

Bearing testing. Dimesional control; Radial clearance determination; Noise and vibrations; Rezidual magnetism; Hardness testing; Acreditated laboratory for rolling bearing testing (LIMES) presentation.

prerequisite

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learning resources

Acreditated laboratory for machine elements and systems testing (LIMES). Laboratories of Machine Design Department.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0; test/colloquium: 0; laboratory exercises: 30; calculation tasks: 15; seminar works: 0; project design: 30; final exam: 25; requirements to take the exam (number of points): 35

references

Sliding and rolling bearings, V.Krsmanović, R.Mitrović, Facultz of Mechanical Engineering, Belgrade, 2004.
Manuals
Presentations
Handouts

Software Tools for Project Management

ID: PhD-3347
teaching professor: Babić R. Bojan
ECTS credits: 5

goals

Project Management deals with seeking new methods of planning, organizing, and controlling non-routine tasks. The management of a project differs in several ways from management of a typical enterprise. The goal of a project team is to accomplish its prescribed mission and then disband; though this is easier said than done. Project Management has been around for some time, though it has recently become more important because of the shifting emphasis on teams in accomplishing tasks. Modern methods of defining, planning and managing large projects. Computer software and network modeling are used to support the efficient scheduling of interdependent activities.

learning outcomes

By successfully completing this course, students will be able to:
1. Understand the concepts of project planning and organization, budgeting and control, and project
life cycles.
2. Understand concepts related to organizational workflow including the staffing process, project planning elements, and the project plan contents and project communications.
3. Master several basic project scheduling techniques and resource constrained scheduling.
4. Understand the related concepts of organizational forms, conflict resolution, and issues related to leadership and task management in a project environment.
5. To use software tools for project management.

theoretical teaching

Managing Projects With Software Tools (Creating A New Project Plan, Defining Project Properties)
Creating a Task List (Entering Tasks, Defining the Right Tasks for the Right Deliverable, Estimating Durations, Entering a Milestone, Organizing Tasks into Phases, Top-Down and Bottom-Up Planning, Linking Tasks, Documenting Tasks, Checking the Plan's Duration)
Setting Up Resources (Setting Up People Resources, Setting Up Equipment Resources, Setting Up Material Resources, Entering Resource Pay Rates, Project Management Focus: Getting Resource Cost Information, Adjusting Working Time for Individual Resources, Documenting Resources)
Assigning Resources to Tasks (Assigning Resources to Tasks, Assigning Additional Resources to a Task, Assigning Material Resources to Tasks)
Formatting and Printing Your Plan (Creating a Custom Gantt Chart View, Drawing on a Gantt Chart, Formatting Text in a View, Formatting and Printing Reports)
Tracking Progress on Tasks (Saving a Project Baseline, Tracking a Project as Scheduled, Entering a Task's Completion Percentage, Entering Actual Values for Tasks)
Managing A Complex Project

practical teaching

Demonstration of project control and reporting techniques by using appropriate project management software. The following phases should be covered: Project initiation phase – Creation of initiation report, Making of conception report, Feasibility report forming.

prerequisite

Defined by curriculum of study programme/module.

learning resources

Appropriate software packages will be needed to demonstrate project control and reporting techniques. Packages might include time and cost scheduling packages, documentation and procurement control packages, spreadsheet packages, graphic presentation packages.
B. Babic, Electronic classrom for distance learning (http://147.91.26.15/moodle/), University of Belgrade, Faculty of Mechanical Engineering, 2011,

number of hours

lectures: 35
research: 0

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

Harvey Maylor, Project Management, Financial Times Press, 2010
Carl Chatfield and Timothy Johnson, Microsoft Office Project 2003 Step by Step, Microsoft Press, 2004

Solar systems

ID: PhD-3072
teaching professor: Živković D. Branislav
ECTS credits: 5

goals

Capacity development for the individual and team work in the field of Solar energy application. Development and synthesis of complex technical solutions,related to the Ph.D dissertation.

learning outcomes

PhD student who listenes to and passes this subject is capable to independently observe, formulate and solve problems using modern methods, independently and in a team organize and conduct research, makes objective conclusions and to suggest appropriate solutions in the area of Solar energy application.

theoretical teaching

The Sun as a heat source. The physical laws of heat transfer of solar radiation. The geometry of the Sun's rays. Turbidity of the atmosphere. The transformation of Solar radiation into electricity and heat. Passive Solar systems: storage walls, convective circuits, hybrid systems. Thermal comfort in buildings with passive Solar energy use for heating. Active Solar systems. Types of Solar energy collectors. Application of Solar energy for heating, cooling and domestic hot water. Automatic control of the Solar system. Heat storage systems for application of Solar energy. Coupling with conventional systems. Cost-effectiveness of Solar systems.

practical teaching

-

prerequisite

There are no requirements

learning resources

-

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

ASHRAE Handbook - Fundamentals, ASHRAE Publication Sales, Tullic Circle NE, Atlanta Georgia 2009
ASHRAE Handbook - HVAC Applications, ASHRAE Publication Sales, Tullic Circle NE, Atlanta Georgia 2011
Cook, J.: Passive Cooling, MIT, Cambridge, MA, 1989
Edwards, D.K.: Spectral and directional thermal radiation characteristics of selective surfaces, Solar Energy, 1962
Scientific and technical papers related to the specific topics

Solar Systems

ID: PhD-3396
teaching professor: Živković D. Branislav
ECTS credits: 5

goals

Capacity development for the individual and team work in the field of Solar energy application. Development and synthesis of complex technical solutions,related to the Ph.D dissertation.

learning outcomes

PhD student who listenes to and passes this subject is capable to independently observe, formulate and solve problems using modern methods, independently and in a team organize and conduct research, makes objective conclusions and to suggest appropriate solutions in the field of Solar energy application.

theoretical teaching

The Sun as a heat source. The physical laws of heat transfer of solar radiation. The geometry of the Sun's rays. Turbidity of the atmosphere. The transformation of Solar radiation into electricity and heat. Passive Solar systems: storage walls, convective circuits, hybrid systems. Thermal comfort in buildings with passive Solar energy use for heating. Active Solar systems. Types of Solar energy collectors. Application of Solar energy for heating, cooling and domestic hot water. Automatic control of the Solar system. Heat storage systems for application of Solar energy. Coupling with conventional systems. Cost-effectiveness of Solar systems.

practical teaching

-

prerequisite

There are no requirements

learning resources

-

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

ASHRAE Handbook - Fundamentals, ASHRAE Publication Sales, Tullic Circle NE, Atlanta Georgia 2009
ASHRAE Handbook - HVAC Applications, ASHRAE Publication Sales, Tullic Circle NE, Atlanta Georgia 2011
Cook, J.: Passive Cooling, MIT, Cambridge, MA, 1989
Edwards, D.K.: Spectral and directional thermal radiation characteristics of selective surfaces, Solar Energy, 1962
Scientific and technical papers related to the specific topics

Sorption Refrigeration Systems

ID: PhD-3385
teaching professor: Kosi F. Franc
ECTS credits: 5

goals

Achieving competency in individual and team research work in the field of sorption refrigeration technology. Improving understanding of the sorption process, the analysis and synthesis of complex technical refrigeration and trigeneration systems, in full accordance with the defined basic tasks and objectives of the study program.

learning outcomes

PhD student acquires specific skills to self-observe, formulate and solve relevant problems by using modern methods of testing and analysis of complex technical systems; as part of a team, organizes and conducts research, draws conclusions and proposes appropriate solutions.

theoretical teaching

Vapour absorption refrigeration systems: properties of refrigerant-absorbent mixtures, basic principle of sorption refrigeration systems, basic steady-flow processes with binary mixtures (adiabatic mixing of two streams, throttling process), maximum COP of ideal absorption refrigeration system.
Vapour absorption refrigeration systems based on water-lithium bromide pair (vapour pressure of water-lithium bromide solutions (Raoult's law, Dühring plot)
Steady flow analysis of water-lithium bromide systems: commercial water-lithium bromide systems (single effect systems, multi-effect systems), absorption cycle modeling analysis and performance simulation (single and double-effect cycle), solar energy driven sorption systems.
Vapour absorption refrigeration systems based on ammonia-water pair: properties of ammonia-water solutions, enthalpy-composition diagram for ammonia-water mixtures, principle of rectification column and dephlegmator, steady-flow analysis of the system, absorption cycle modeling analysis and performance simulation, pumpless vapour absorption refrigeration systems
Gas cooling and cogeneration: gas cooling, cogeneration, gas-engine chiller, trigeneration system, typical modes for application of trigeneration system with gas type lithium bromide absorption chiller/heaters
Absorption heat pumps (heat from a low-temperature heat source)
Absorption heat transformer (operating characteristics, thermodynamic analyses of process quality).

practical teaching

prerequisite

no specific conditions, useful basic knowledge in thermodynamics

learning resources

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 0

references

Niebergall, W., Sorptions-Kältemaschinen, Vol. 7 of Handbuch der Kältetechnik, Ed. R. Plank, Springer-Verlag, Berlin, 1959.
ASHRAE Handbook of Fundamentals, Chapter 2 Thermodynamics and Refrigeration Cycles, ASHRAE, Atlanta, 2009.
ASHRAE Handbook of Fundamentals, Chapter 20, Thermophysical Properties of Refrigerants, ASHRAE, Atlanta, 200
Shan K. Wang, Handbook of Air Conditioning and Refrigeration, McGraw-Hill, Second Edition, 2001.
Kreith F., Kreider J. F. Principle of solar engineering. Washington: Hemisphere Publication Corporation; 1978. P. 493.

Special Topics in Air Conditioning

ID: PhD-3395
teaching professor: Živković D. Branislav
ECTS credits: 5

goals

Capacity development for the specific topics in the field of air conditioning, strongly related to the Ph.D dissertation. Development of creative research.

learning outcomes

Expert with a significantly expanded and deepened knowledge on the specific topics in the field of air conditioning. PhD student who listenes to and passes this course is capable to independently observe, formulate and solve problem using modern methods, independently organize and conduct research, make objective conclusions and suggest appropriate solution.

theoretical teaching

Calculation of unsteady heat transfer through the building envelope. Detailed calculation of energy consumption for heating, ventilation and air conditioning for different types of buildings. Energy efficient measures for reducing energy consumption in a building. Use of Renewable Energy sources and new technologies in combination with conventional systems and fossil fuels. Appropriate technical solutions for reduction of carbon dioxide and other green house gasses emission. Other topics in the field of air conditioning related to the dissertation.

practical teaching

-

prerequisite

There are no requirements

learning resources

-

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

ASHRAE Handbook - Fundamentals, ASHRAE Publication Sales, Tullic Circle NE, Atlanta Georgia 2009
ASHRAE Handbook - HVAC Applications, ASHRAE Publication Sales, Tullic Circle NE, Atlanta Georgia 2011
ASHRAE Handbook - HVAC Systems and Equipment, ASHRAE Publication Sales, Atlanta Georgia 2008
Scientific and technical papers related to the specific topics

Stability of Motion of a System

ID: PhD-3171
teaching professor: Mitrović S. Zoran
ECTS credits: 5

goals

Training students to independently research in the field of stability of motion of holonomic and nonholonomic mechanical systems, particularly in the case of the stability of the equilibrium position of the stationary motion of mechanical systems, as models of real technical objects.

learning outcomes

After this course, students will be able to independently solve problems of stability of mechanical systems.

theoretical teaching

Nondisturbed and disturbed motion. Stability of a motion. Differential equations of a disturbed motion. Direct Lyapunov's method. Lyapunov functions. Lyapunov's theorem of a stability. Lyapunov's theorem of a asymptotic stability. Lyapunov's theorem of a instability. Chetayev's theorem. Lyapunov function and first integrals. Stability in relation to a part of variables. Stability in linear approximation. Stability of equilibrium state and stationary motion. Stability of equilibrium state of conservative systems. Influence of gyroscopic and dissipative forces. Stability of equilibrium state and stationary motion of a nonholonomic systems.

practical teaching

prerequisite

Defined by the curriculum study of Phd studies program.

learning resources

Bakša A.,Vesković M., Stability of a motion (in Serbian), Faculty of Mathematics, Belgrade, 1996.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

Malkin I., Theory of Stability of a Motion, (in Russian), Nauka, Moscow, 1966.

Steam Turbines - Advanced course

ID: PhD-3389
teaching professor: Petrović V. Milan
ECTS credits: 5

goals

1. The achievement of research and expert competence in the field of steam turbines.
2. The achievement of high level of theoretical knowledge
3. The acquisition of research and expert knowledge in steam turbines.
4. The achievement of the techniques of process modeling.
5. Mastering the methods of experimental work in thermal power engineering.

learning outcomes

1. Expert and research deep knowledge of steam turbines.
2. The development of critical thinking about energy use, fuel efficiency and environmental preservation
3. The ability of calculate steam turbines.
4. Ability to use computer technology for modeling and calculations

theoretical teaching

Introduction. Thermodynamic Cycles. Selection and optimization of the cycle parameters. Energy and exergy analysis of the steam turbine cycles. Cascade Theory. Loss and deviation models. Stage Theory and 1D Design.
Project: Steam Turbine Power plant: Calculation of the heat balance diagram and energy and exergy analysis.

practical teaching

Project: Steam Turbine Power plant: Calculation of the heat balance diagram and energy and exergy analysis.

prerequisite

PhD Student - Thermal power engineering.

learning resources

Literature. Lab. Experimental facilities. Computing facility.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Petrovic, M.: Steam turbines, script, 2004.
Stojanovic, Themal Turbomachinery, Gradjevinska knjiga, Belgrade, 1967.
Traupel,W.: Thermische Turbomaschinen, Springer verlag, Berlin, 1982
A. Leizerovich: Steam Turbines for Modern Fossil-Fuel Power Plants
Lakshninarajana, B: Fluid Dynamics and Heat Transfer of Turbomachinery, Wiley, 1996,

Stress and strain measurement

ID: PhD-3161
teaching professor: Milovančević Đ. Milorad
ECTS credits: 5

goals

The main aim is to master the experimental methods for measuring stress and strain construction. Introducing the achievements and possibilities of modern methods of measurement. Accent is given to the processing ekstenziometrijskih and optical methods with modern electronics and optics.

learning outcomes

Methods can be applied to models and real structures. Experimental methods of analysis allows for obtaining data relevant to the analysis of the structure and to assess its strength and stability.

theoretical teaching

Basic concepts of development and the importance of experimental methods to the study design. A brief review of existing methods of measurement. Strain gauge measurement methods. Optical methods of measurement. Interferometric and holographic methods. Methods brittle varnish. Inductive, capacitive and magnetic measurement methods.

practical teaching

The practical application of the experimental method of measuring stress and strain on the structural model in the laboratory.

prerequisite

No conditions.

learning resources

1. Handauts from the website of Department.
2.V.Brcic, R.Cukic,Experimental methods in the design of structures, building books, Belgrade (1988)

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Structural Diagnostics

ID: PhD-3355
teaching professor: Maneski Đ. Taško
ECTS credits: 5

goals

Mastering of the Diagnostics Method and an active work on the computer. Modeling and calculation of complex structures and problems. Determination Finding the real structure behavior in its operation. Reliable prediction of structural response and determination the cause of bad behavior, yielding and damage of structure. Static, thermal and dynamic analysis.

learning outcomes

The course provides skills to diagnostics behaviour of structures using computers and Finite Element Method. This allows solving the real problems of structural strength in its service life. Mastering the course will enable the application on different areas and active work on the computer using finite element method.

theoretical teaching

Introduction. Based method of stucture behaaviour diagnostics. The based of modeling. Static and thermal analysis. Dynamic analysis. Analysis of the calculation of structure. Computer modeling and calculation of real problems. Load distribution in the structure. Diagnosis of the strength of structure behaviour. Elements of structure optimization.

practical teaching

Working with Programe package KOMIPS. The tasks from line primitives. The tasks of surface primitives. The tasks of volume primitives. Principles of computer modeling and generation of structure geometry. Adding primitives to generate finite element meshes. Computer modeling of supports and loads. Exercise of collecting primitives and generating network elements. Exercise of defining the characteristics of elements, supports and loads. Examples of static and thermal calculation. Examples of dynamic calculation. Diagnostics of structural behavior. Seminar papers from modeling, calculations, load distribution on the structure, analysis of structure calculation, defining elements of structure optimization.

prerequisite

No conduction

learning resources

1. T. Maneski, Computer modeling and calculation of structures, Faculty of Mechanical Engineering, 1988 - KPN
2. T. Maneski, V.Milošević-Mitic, D. Oštrić, The statement of structural strength, Faculty of Mechanical Engineering, Belgrade, 2000 - KPN
3. T. Maneski, Resolved problems of structural strength, faculty of Mechanical Engineering, Belgrade, 2000 - KPN
4. KOMIPS - a software package for the calculation of structures - ICT - IAS

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Structural Integrity

ID: PhD-3333
teaching professor: Sedmak S. Aleksandar
ECTS credits: 5

goals

To provide a basic knowledge about Structural Integrity, based on Fracture Mechanics concepts. Course provides all necessary information on theoretical, analytical, numerical and experimental approach toward evaluation of fracture mechanics parameters as a crack driving force on one hand side and as a material resistance to cracking, on the other hand side, enabling Structural Integrity assessment of any structure needed. Course objectives are that students, after completing basic course in theory of fracture mechanics, and with their maximum involvement in practical training (through laboratory exercises, development of computational tasks, writing seminar papers, etc.); become competent in assessment of safety and integrity of structures. The potential co-operation with experts in the field of fracture mechanics is allowed, and through theoretical and practical training the appropriate academic skills are acquired, and they 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 of structural integrity, and to examine the possible consequences that may occur in case of bad solutions. By attending this course students will master the prediction techniques of residual strength of structures with cracks, fracture toughness testing techniques for metallic materials and welds. Students learn about possible practical applications of fracture mechanics based on a double-sided interpretation of its parameters, when setting up the fracture mechanics triangle provides an estimation of reliability structures. The practical application of fracture mechanics in order to prevent failure of real structures is analized.Students learn about issues involving analysis and diagnosis of behavior and lost of integrity, life assessment and rehabilitation of structures. It is anticipated to master weak spot prediction techniques in structural design, even before the appearance of cracks, as well as structural assessment when an error is detected using nondestructive testing methods. The student will also able to link their knowledge in this field with other areas and apply them in practice.

theoretical teaching

LEFM, Stress distribution & concentration, atomic view. LE Fracture toughness testing. EPFM basics, parameters. SI basics, methods. Application of fracture mechanics to structural integrity assessment. Initiation of a crack in a weldment. The possibility of using fracture mechanics criteria to assess safety of welded joints. Mechanical structures integrity considering fracture toughness. Damage mechanics and its application to ductile fracture. Estimates in the domain of elasticity and elasto-plasticity. Residual strength assessment of pressure vessels with surface errors using the resistance curves. Crack growth force in relation to the tensile engineering materials curves. Fracture mechanics analysis and allowed defect size curves for surface cracks in pipes. Fatigue surface crack growth in welded joints. Determination of fracture mechanics parameters with thermo mechanical load. J integral as the law of conservation. Direct measurement of the J integral. Local access.FEM in fracture mechanics.

practical teaching

Griffith, Fracture toughness, LEFM examples & overview. Standard procedures for the fracture mechanics measurement, as material properties. EP Fracture toughness testing. SI examples. EPFM, parameters evaluation (theoretical, exp. Numerical). EPFM, overview & examples. Fracture diagram analysis and its application to welded joints and structures. Application of linear elastic fracture mechanics. Application of the leak principles before fracture design. The application of elastic-plastic fracture mechanics. CTOD design curve. Failure Assessment Diagrams. PD6493 procedures. R6 method. J-integral analysis of crack growth. Structural integrity assessment using acquired knowledge. Directly measuring the J integral - Reed's original work. Examples of modifications - the strength and heterogeneity of material. An example of two-dimensional stress analysis - pressure vessels. Assessment of properties of welded joints using standard cracked specimens. Consultation.

prerequisite

learning resources

[1] Written lessons from lectures (handouts)
[2] A. Sedmak, Use of the fracture mechanics on the structure integrity assessment, Faculty of Mechanical Engineering, Belgrade, 2003.
[3] T.L. Anderson, Fracture Mechanics: Fundamentals and Applications, 3rd ed, CRC Press, London, 2005.
[4] Excerpts from the standard

number of hours

lectures: 35
research: 0

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): 40

references

T.L. Anderson, Fracture Mechanics: Fundamentals and Applications 3rd ed. CRC Press, London, 2005.
Jin Z. H., Sun C.T., Fracture Mechanics, Academic Press, 2011.
G. Pluvinage, Fracture and Fatigue Emanating from Stress Concentrators, Springer, Dordrecht, 2004.
A. Sedmak, S. Sedmak, LJ. Milović, Pressure eljuipment inegrity assessment bz elastic-plastic fracture mechanics methods, monografija, DIVK, Beograd, 2011.
Broek D., The Practical Use of Fracture Mechanics, Springer, 1989.

Structure testing methods

ID: PhD-3198
teaching professor: Ognjanović B. Milosav
ECTS credits: 5

goals

Involve the students in research methodology by application of experimental methods. Introduce PhD students with the types, application procedure and with data processing of laboratory and exploitation testing of machine systems structures. To trained them in preparation and caring out of experiments and in using of experimental data.

learning outcomes

PhD student skills for experimental methods application (in laboratory and in service conditions), for data processing and for data implementation. PhD student is ready for carrying out of experiments in research projects, in scientific works preparation and for carrying out of experiments for PhD thesis preparation.

theoretical teaching

Introduction: The role of experimental results in comparing with analytical and numerical ones. Method of physical values measurement in solid structures (deformation, stress, load ...). Methods of machine systems testing in service conditions (preparation, organization and carrying out of experiments). Laboratory testing methods without machine parts failures. Testing methods to the failure (fatigue testing of models and real machine components – examples and characteristics). Statistical processing of fatigue testing results. Testing of machine components reliability. Vibration and noise testing of machine systems components. Frequency analysis of vibration and noise measured results. Diagnosis of conditions in machine systems.

practical teaching

Work in laboratory. Testing process preparation and testing realization. Experimental results processing. Seminar work processing. Defense of seminar work.

prerequisite

It is no conditions for the subject attending.

learning resources

Laboratory for gears and gear transmission units. Laboratory for vibration and noise of machine systems components.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

1. John J.A., Quenouille M.H.: EXPERIMENTS: Design and Analzsys, - Griffin – London 1997.
2. Jeff Wu C.F., Homada M.: EXPERIMENTS: Planing, Analysis and Parameters Design Optimisation, - Wiley, New York 2000.

Structure Testing Methods

ID: PhD-3335
teaching professor: Ognjanović B. Milosav
ECTS credits: 5

goals

Involve the students in research methodology by application of experimental methods. Introduce PhD students with the types, application procedure and with data processing of laboratory and exploitation testing of machine systems structures. To trained them in preparation and caring out of experiments and in using of experimental data.

learning outcomes

PhD student skills for experimental methods application (in laboratory and in service conditions), for data processing and for data implementation. PhD student is ready for carrying out of experiments in research projects, in scientific works preparation and for carrying out of experiments for PhD thesis preparation.

theoretical teaching

Introduction: The role of experimental results in comparing with analytical and numerical ones. Method of physical values measurement in solid structures (deformation, stress, load ...). Methods of machine systems testing in service conditions (preparation, organization and carrying out of experiments). Laboratory testing methods without machine parts failures. Testing methods to the failure (fatigue testing of models and real machine components – examples and characteristics). Statistical processing of fatigue testing results. Testing of machine components reliability. Vibration and noise testing of machine systems components. Frequency analysis of vibration and noise measured results. Diagnosis of conditions in machine systems.

practical teaching

Work in laboratory. Testing process preparation and testing realization. Experimental results processing. Seminar work processing. Defense of seminar work.

prerequisite

It is no conditions for the subject attending.

learning resources

Laboratory for gears and gear transmission units. Laboratory for vibration and noise of machine systems components.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

1. John J.A., Quenouille M.H.: EXPERIMENTS: Design and Analzsys, - Griffin – London 1997.
2. Jeff Wu C.F., Homada M.: EXPERIMENTS: Planing, Analysis and Parameters Design Optimisation, - Wiley, New York 2000.

Substitution of Manual Tasks in Food Industry

ID: PhD-3151
teaching professor: Miladinović D. Ljubomir
ECTS credits: 5

goals

In order to increase productivity, reduce production costs in various industries, as well as the development of different fields of science dealing with rehabilitation and support of disabled persons, it is necessary to simulate or replace human labor or movement with mechanical or mechatronic systems. The complexity of these systems is very large and the degree of integration of various scientific and engineering fields is high. The integration of different types of knowledge, technology and techniques requires exceptional creativity, analytical and research skills.

learning outcomes

After completing these classes Students should be capable to integrate, in an inventive way, existing knowledge and technology, the knowledge and technologies that will emerge in the future, in systems for the substitution of human labor and simulation of human movement. One of the most important outcomes is the adoption of the way of thinking and logic in the synthesis of such systems

theoretical teaching

Principles of analysis of human movement. Techniques for use of this analysis in the integration of mechatronic systems. Existing driving systems. Basics of the synthesis of mechanisms. Sensors. Basics of an PLC. Introduction to the existing solutions, especially in the food industry.

practical teaching

prerequisite

learning resources

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Surface Engineering

ID: PhD-3031
teaching professor: Vencl A. Aleksandar
ECTS credits: 5

goals

The student attending this course should:
• Get familiar with the characteristics of surfaces exposed to friction and wear, as well as to get familiar with the possible interactions of surfaces with lubricant in the lubrication conditions;
• Understand the impact of individual characteristics on the size of the friction and wear at the macro, micro and nano level;
• Learn the basic principles of the most common techniques of surface modification and coating deposition processes.

learning outcomes

On the basis of mastered knowledge the student is qualified to deal with the fundamental aspects of friction and wear, as well as to solve specific tribological problems (primarily to reduce friction and wear) using some of the surface modification methods and/or some of the coating deposition techniques.

theoretical teaching

Study of the nature and characteristics of metallic and non-metallic materials surfaces, from the standpoint of values influencing the friction and wear. Analysis of the surface texture and roughness parameters, including statistical methods and experimental measurements. Geometrical and real area of contact. Mechanics of contact area, i.e. the stress distribution under load (Hertz contact). The runn-in process and thermal effects, i.e. calculation of the surface temperature. Mechanical and chemical interaction of surfaces exposed to friction and wear. Antiwear coatings and methods of surface modification. A separate chapter deals with the study of friction, wear and lubrication at the nano scale, i.e. nanotribology.

practical teaching

prerequisite

learning resources

1. A. Rac, Fundamentals of Tribology, Faculty of Mechanical Engineering, Belgrade, 1991, (in Serbian).
2. A. Rac, Lubricants and Machine Lubrications, Faculty of Mechanical Engineering, Belgrade, 2007, (in Serbian).
3. T.R. Thomas, Rough Surfaces, Imperial College Press, London, 1999.
4. F.F. Ling, Surface Mechanics, John Wiley & Sons, New York, 1973.
5. G.E. Totten, H. Liang, Surface Modification and Mechanisms, Marcel Dekker, New York, 2004.
6. K. Holmberg, A. Matthews, Coatings Tribology, Elsevier, Amsterdam, 2009.
7. E. Gnecco, E. Meyer, Fundamentals of Friction and Wear on the Nanoscale, Springer, Berlin, 2007.
8. B. Bhushan (Ed.), Nanotribology and Nanomechanics: An Introduction, Springer, Berlin, 2005.

number of hours

lectures: 35
research: 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: 70; project design: 0; final exam: 30; requirements to take the exam (number of points): 35

references

N.D. Spencer, Tailoring Surfaces – Modifying Surface Composition and Structure for Applications in Tribology, Biology and Catalysis, World Scientific Publishing, Singapore, 2011.
C.M. Preece (Ed.), Treatise on Materials Science and Technology – Erosion, Vol. 16, Academic Press, New York, 1979.
D. Scott, ed., Treatise on Materials Science and Technology – Wear, Vol. 13, Academic Press, New York, 1979.
C. Mathew Mate, Tribology on the Small Scale, Oxford University Press, New York, 2008.
B. Bhushan (Ed.), Handbook of Micro/Nano Tribology, CRC Press, Boca Raton, 1999.

Systems Effectiveness in Mechanical Engineering

ID: PhD-3026
teaching professor: Vasić M. Branko
ECTS credits: 5

goals

The objectives of the course are to provide a comprehensive insight into the issues (analysis and design) of system effectiveness, primarily in the areas of reliability and availability of technical systems (vehicles), maintenance, maintainability and life cycle. The course is intended for Ph.D. students of Motor Vehicles department, and it provides insight into the analysis and design of the effectiveness of the system (vehicle).

learning outcomes

Mastering the study program a student obtains general and subject-specific skills which are in a function of the contemporary approach to the analysis and design of technical systems (vehicles). The students acquire a basic ability to access the full access to today's analysis and design effectiveness (reliability, maintenance, maintainability), a perception of the life-cycle systems, and solving complex problems in this area.

theoretical teaching

practical teaching

prerequisite

learning resources

1. J. Todorovic, B. Vasic: System Effectiveness, Faculty of Mechanical Engineering, Belgrade 1991.
2. B. Vasic, N. Stanojevic: Integrated Cost-Benefit and Multi-Criteria Analyses Based on the Principles of Life Cycle Engineering, MIRCE Science Limited, UK, 2007.
3. B. Vasic, V. Popovic: Engineering management metods, Institute for research and design in comerce & industry, Belgrade, 2007.
4. Vasic, B. : Management and Engineering in Maintenance, IIPP, 2004.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Systems Engineering - Selected Items

ID: PhD-3027
teaching professor: Vasić M. Branko
ECTS credits: 5

goals

Course objectives include the achievement of competencies and academic skills as well as methods for their acquisition, in the field of engineering systems. The goals arising from basic tasks and determine the specific results that should be realized within the subject and represent the basis for the control of the results achieved.

learning outcomes

Students obtain the following general ability:
- analysis, synthesis and forecasting of solutions and consequences
- mastering the methods, procedures and processes of research,
- application of acquired knowledge into practice.

Students acquire and subject-specific skills:
- thorough introduction to systems engineering,
- solving concrete problems by using scientific and engineering methods and procedures,
- development of the skills for the use of knowledge in the field of engineering systems.

theoretical teaching

Five main teaching blocks include the following areas: (a) Introduction to systems (definitions, concepts, process), (b) The process of system design (preliminary and detailed design, development, testing and evaluation), (v) analysis of system and project evaluation (alternatives and models in decision making, models of economic evaluation, optimization techniques in the design of control), (g) designing for reliability, maintainability, usability (human factors), logistic support, and (d) management of engineering systems (program planning, organization, control).

practical teaching

prerequisite

learning resources

1. Vasic B., Todorovic J., et al.: Maintenance of Technical Systems, Institute for Research and Design in Commerce & Industry, Belgrade, 2006.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Systems of artificial neural networks

ID: PhD-3168
teaching professor: Miljković Đ. Zoran
ECTS credits: 5

goals

Artificial neural networks (ANNs) present one of the most important and widely used artificial intelligence paradigm. Thus, this subject aims to enable PhD students for idependent development, modelling and application of artificial neural networks in domain of complexity of intelligent machine systems through theoretical and practical aspects of learning algorithms and neural networks training.

learning outcomes

The outcome of this subject considers the suitability for modelling and predicting changes of functional characteristics of systems and processes besides the introduction of PhD students into the basic methodology of complex problems modelling in mechanical engineering by the use of artificial neural networks which are able to learn and generalize the nature of phenomena on the basis of known experimental data. They can be trained in such way to find the solution, recognize the behaviour models, classify data and predict future events.

theoretical teaching

Theoretical education is organized into several parts: • Intelligent formalized methodology and soft computing - Adaptive processing and role of artificial neural networks (ANNs) in development of soft computing techniques, the history of development of ANNs; • ANNs-basic concepts - Structure of ANNs, processing element-neuron, activation function, learning algorithms of ANNs, simulation of neural networks; • Models of ANNs - basic paradigms and examples; • Homogeneous ANNs - Perceptron, Back propagation (BP) neural network, ART neural networks, self-organizing map (SOM), etc.; • Heterogeneous ANNs (membrane potential, neural model, neural controller).

practical teaching

Practical education is organized into several parts: • ANNs in intelligent technologies - formalized conceptual design, group technology, feature recognition and part representation, process planning, scheduling, recognition systems - image processing and analysis, monitoring and diagnostic of manufacturing processes, intelligent control of robots and machine systems, application in business and finances; • Developed software and their application - ART-Simulator, Matlab, Neuro Solutions, etc.

prerequisite

MSc degree of technically oriented faculty.

learning resources

[1] Z. Miljković, D. Aleksendrić, ARTIFICIAL NEURAL NETWORKS – solved examples with theoretical background, Textbook, University of Belgrade, Faculty of Mechanical Engineering, 2009, 18.1 /In Serbian/
[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] Software packages (BPnet, ART-Simulator, Matlab), Laboratory CeNT, University of

Belgrade, Faculty of Mechanical Engineering, 18.13
[4] Laboratory mobile robot prototype (Khepera II, LEGO Mindstorm NXT), Laboratory CeNT, University of Belgrade, Faculty of Mechanical Engineering, 18.12
[5] Laboratory model of designed manufacturing system, Laboratory CeNT, University of Belgrade, Faculty of Mechanical Engineering, 18.12

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Z.Miljković, D.Aleksendrić, (2009) ARTIFICIAL NEURAL NETWORKS–SOLVED EXAMPLES WITH THEORETICAL BACKGROUND (in Serbian). University of Belgrade–Faculty of Mechanical Engineering, Belgrade.
Freeman, J.A., Skapura, D.M., (1991) NEURAL NETWORKS – ALGORITHMS, APPLICATIONS AND PROGRAMMING TECHNIQUES, Addison-Wesley Publishing Company.
Golden,R.M., (1996) MATHEMATICAL METHODS FOR NEURAL NETWORK ANALYSIS AND DESIGN, MIT Press.
Skapura,D.M., (1996) BUILDING NEURAL NETWORKS, Addison-Wesley Publishing Company.
Zalzala,A.M.S.,Morris,A.S., (1996) NEURAL NETWORKS FOR ROBOTIC CONTROL -THEORY AND APPLICATIONS, Ellis Horwood Limited.

Technical Legislation - Directives and Standards

ID: PhD-3177
teaching professor: Mitrović M. Radivoje
ECTS credits: 5

goals

Acquiring of advanced knowledge in the field of technical regulations and standards. Fully understanding the mutual correlation between international and national technical regulations. Full training for the project documentation making in terms of respect for the essential requirements relevant to technical regulations and standards.

learning outcomes

Students gain advanced knowledge about the content, significance and types of technical regulations and standards, technical legislation of EU directives, conformity assessment procedures, notified bodies, CE marking, market surveillance, machinery safety, risk assessment and national legislation on safety and health at work. The acquisition of appropriate competencies, skills and know-how to use the appropriate technical regulations and standards.

theoretical teaching

The role, importance and types of technical regulations in mechanical engineering. The place and role in the process of technical regulations and machinery design. Standardization. Application scope. Lows about standardization. Low of Accreditation. Low of Metrology. Lows of Technical Directives. Directives and other regulatory legislation documents. EU technical legislation. EU directives. The meaning of new and global approach. Scope of application of the New Approach Directives. Products and goods covered by directives. Compatibility to the Directives. Standard procedure for conformity assessment. Modules. Quality standards application. Notified bodies. Principles of Accreditation. The process of certification. Notified bodies and subcontracting. Coordination and cooperation of notified bodies. CE marking. The principles of the CE markings. Products which is marked with CE. Market surveillance. Principles of market surveillance. Machinery safety. Reliability. Hazard. Risk. Functions of machinery safety. Safety protection. Manual Instruction. Strategy for selection of safety measures. Risk assessment. The evaluation of risk. Law on Safety and Health at work.

practical teaching

Examples of application and use of various types of technical regulations and standards in the construction and design process. Examples of formation and complete technical documentation for obtaining the CE mark for the product. Examples of forming and completing the documentation for the accreditation of laboratories for product testing. Examples and conformity assessment of products. Examples of designing technical solutions for machinery safety and protection. Example of making manual instructions for machinery, equipment or installations. Examples of risk assessment for machinery and mechanical systems. Examples of completing a documentation for the risk assessment. During course, students will visit the following institutions:
- Certified Laboratory for Machinery Elements and System Testing - LIMES, University of Belgrade, Faculty of Mechanical Engineering;
- The Intellectual Property Office of Republic of Serbia;
- Institute for Standardization of Serbia;
- Notified Body of Vinča Institute.

prerequisite

There are no special requirements for attending the course.

learning resources

- Teaching material: Instructions for the application of directives based on new approach and global approach - Danish Technological Institute (translated version) 2006, EU Directive, EU Standards, Standards of Republic of Serbia, the Law on Standardization, the Law on Accreditation Act, the Law on Metrology, Lawc on technical regulations. Required additional materials (handouts, Directives Of Republic of Serbia, etc..) are given at the web site or as a hard copy. Large-scale electronic materials can be made available to students in direct contact.
- Computer equipped classroom;
- Access to Internet;
- Laboratory for General Machine Design, University of Belgrade, Faculty of Mechanical Engineering;
- Certified Laboratory for Machinery Elements and System Testing - LIMES, University of Belgrade, Faculty of Mechanical Engineering;
- Certified Laboratory for Vehicle Testing - CIAH, University of Belgrade, Faculty of Mechanical Engineering;

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

EU Directives (MD, LVD, EMC, HACCP, ATEX,...)
Actual Directives and regulation books of Reublic of Serbia
Technical regulations and standards, textbook in preparation

Tensor Calculus

ID: PhD-3078
teaching professor: Zeković N. Dragomir
ECTS credits: 5

goals

-to provide students knowledge of the fundamental principles and methods in Tensor Calculus
-to enable students to solve practical problems in Tensor Calculus using acquired knowledge in Tensor Calculus
-to prepare students to monitoring novelties in science and engineering

learning outcomes

-to enable students to master terms, methods and principles in Tensor Calculus
-to enable students to relate the knowledge from Tensor Calculus with knowledge in other scientific fields, to apply knowledge from Tensor Calculus in analysis, synthesis and prediction of solutions and consequences of problems in science

theoretical teaching

Basic basis. Conjugated basis. Components of metric tensor. Dyadic product. Bivalent tensors. Tensors of higher valence. Metric tensor. Simple operations over tensors. Symmetric and anti-symmetric bivalent tensors. Scalar product of tensors. Double scalar product of tensors. Pseudo-tensors. Vector product of tensors. Own vectors and own values. Tensor differentiation. Bivalent tensor derivation. Metric tensor differentiation. Tensor divergences. Orthogonal curvilinear coordinates. Lamé's coefficients. Christophel's symbols. Tensor rotor. Laplacian. The application to analytical mechanics and continuum mechanics.

practical teaching

Basic basis. Conjugated basis. Components of metric tensor. Dyadic product. Bivalent tensors. Tensors of higher valence. Metric tensor. Simple operations over tensors. Symmetric and anti-symmetric bivalent tensors. Scalar product of tensors. Double scalar product of tensors. Pseudo-tensors. Vector product of tensors. Own vectors and own values. Tensor differentiation. Bivalent tensor derivation. Metric tensor differentiation. Tensor divergences. Orthogonal curvilinear coordinates. Lamé's coefficients. Christophel's symbols. Tensor rotor. Laplacian. The application to analytical mechanics and continuum mechanics.

prerequisite

Defined by the curriculum study of Phd studies program.

learning resources

[1] Andjelić T.: Tenzorski račun, Naučna knjiga, Beograd, 1980.
[2] Leko M., Plavšić M.: Rešeni problemi iz tenzorskog računa sa primenama u mehanici, Gradjevinska knjiga, Beograd, 1973.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

Andjelić T.: Tenzorski račun, Naučna knjiga, Beograd, 1980.
Leko M., Plavšić M.: Rešeni problemi iz tenzorskog računa sa primenama u mehanici, Gradjevinska knjiga, Beograd, 1973.

Testing and optimization of machine tools

ID: PhD-3040
teaching professor: Glavonjić M. Miloš
ECTS credits: 5

goals

1) To receive basic knowledge about testing of machine tools and machining systems.
2) To receive basic knowledge about methods for machining system optimization.
3) To receive practical knowledge about virtual machining systems.
4) To receive training in testing procedures and optimization methods for machine tools and machining systems.
5) To know how to make technical projects.

learning outcomes

1) Basic know how about testing of machine tools and machining systems.
2) Ability to select and to carry out of methods for machining system optimization.
3) Skill to cope with the virtual machining systems and digital manufacturing.
4) Skill to choose and to carry out integrated testing procedures and optimization methods for machine tools and machining systems.
5) Basic know how about making technical projects and testing and optimization report.

theoretical teaching

New teaching contents:
1) Testing of machine tools and machining systems.
2) Methods for machining system optimization.
3) Virtual machining system and digital manufacturing.
4) Integrated methods for testing and optimization of machine tools and machining systems.
5) Modal analysis.

Elaboration of new teaching contents and instructions for doing the tasks:
1) Planning of one complex machining system testing.
2) Analysis of machining systems optimizations methods.
3) Examples of simulations in virtual machining system.
4) Examples of integrated methods for machine tools and machining systems optimization.
5) Examples of basic modal analysis.

practical teaching

Practical teaching involves laboratory work in Laboratory for machine tools and machining systems, and seminar work writing. Planned experiments are carried out in the Laboratory with finishing the reports. These reports are a part of the seminar work.

prerequisite

Study curriculum and student motivation for learning about testing and optimization of machine tools according to the goals set and outcomes offered.

learning resources

Laboratory for machine tools and machining systems, which includes both hardware and software:

1) Different kinds of sensors (accelerometers, dynamometers etc.).
2) The systems for experimental data conditioning and acquisition.
3) Software for experimental data processing.
4) The systems for laboratory testing of machine tools accuracy.
5) The system for circular interpolation test.
6) Test bed for identifying parameters of mechanistic cutting forces models.
7) Test bed for cutting process optimization, feed scheduling, and integrated simulation of machine tool and process.
8) Software for virtual machining system simulations.
9) Test bed for parallel kinematics machine tools.
10) Test bed for configuring and programming of modular open architecture machine tools (MOMA).
11) Test bed for the STEP-NC protocol based programming of CNC machines.
12) Hardware needed for basic modal analysis (modal hammer, accelerometers etc.).
13) Software for basic modal analysis.
14) Functional simulator of the rapid prototyping machine tool.
15) Software for basic optimization of machine tools structures.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

R. V. Rao, V.J. Savsani, Mechanical Design Optimization Using Advanced Optimization Techniques, Springer, 2012, ISBN 978-1-4471-2747-5.
P. W. Christensen, A. Klarbring, An Introduction to Structural Optimization, Springer, 2009, ISBN 978-1-4020-8665-6.
Z. Zhou, S. (Shengquan) Xie, D. Chen, Fundamentals of Digital Manufacturing Science, Springer, 2012, ISBN 978-0-85729-563-7.
W. Ahmed, K. A. Raouf, K. Cheng, Virtual Manufacturing, Springer, 2011, ISBN 978-0-85729-185-1.
X. Xu, Integrating Advanced Computer-Aided Design, Manufacturing, and Numerical Control: Principles and Implementations, Information Science reference, 2009, ISBN 978-1-59904-714-0.

The higher course of heat and mass transfer operations and apparatus

ID: PhD-3037
teaching professor: Genić B. Srbislav
ECTS credits: 5

goals

Introduction to the trends of research in the field of heat and mass transfer apparatus
Mathematical modeling of the intensity of heat and mass transfer in process equipment

learning outcomes

The application of the basic models of phase fluidodynamic state for estimation of the heat and mass transfer efficiency

theoretical teaching

Introduction and clasification of heat and mass transfer operations. Methods for determining phase equilibrium in multicomponent Multiphase Systems: Ideal and non-ideal systems. Distillation: continuous single stage equilibrium distillation and condensation of multicomponent mixtures, continuous rectification of multicomponent mixtures, distillation with steam and inert gases, Extractive and azeotropic distillation. Absorption and desorption: adiabatic and isothermal absorption (desorption). Extraction and leaching. Adsorption, ion exchange, desorption (regeneration) of adsorbent. One phase heat transfer: heating, cooling. Two phase heat transfer: evaporation, condensation, freezing. Heat and mass transfer operations accompanied with chemical reactions. Optimization capabilities of heat and mass transfer operations and apparatuses.

practical teaching

prerequisite

learning resources

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10; test/colloquium: 50; laboratory exercises: 0; calculation tasks: 10; seminar works: 0; project design: 0; final exam: 30; requirements to take the exam (number of points): 70

references

Jaćimović B., Genić S., Heat Transfer Operations And Equaipment, 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.
Treybal, R.E., MASS-TRANSFER OPERATIONS, McGraw-Hill, New York, 1981.
*** HEAT EXCHANGER DESIGN HANDBOOK, Hempshere, Washington, 1983.

The higher course of process phenomena

ID: PhD-3038
teaching professor: Genić B. Srbislav
ECTS credits: 5

goals

Expansion of basic knowledge in the field of transport phenomena and heat substances in the process industry. Application of steady and unsteady state heat and mass transfer in two phase multiple component systems in process equipment.

learning outcomes

Mastering of mathematical modeling and design procedures necessary to determine the intensity of heat and mass transfer and pressure drop in chemical apparatuses. Training for the research and design in the field of process equipment.

theoretical teaching

Molecular transport phenomena. Steady and unsteady state heat and mass transfer in fluids. Differential equations of convective transport of momentum, heat and substance. Laminar and turbulent flow. Simplified models of convective transport. Analysis of heat and mass transfer resistances. Coefficients of heat and mass transfer. Similarity theory. Analogies between mass, heat and momentum transfer. Mass transfer across a phase boundary. Inter-phase turbulence. Simultaneous mass and heat transfer. Wet-bulb temperatures Boiling, condensation and thermal radiation. Typical cases in process equipment (heat exchangers, columns, furnaces). Unsteady heat and mass transfer in solid phase.

practical teaching

Examples of the research in the field of heat and mass transfer and pressure drop

prerequisite

learning resources

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10; test/colloquium: 50; laboratory exercises: 0; calculation tasks: 10; seminar works: 0; project design: 0; final exam: 30; requirements to take the exam (number of points): 70

references

Jaćimović B., Genić S., Heat Transfer Operations And Equaipment, 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.
Foust, A.S., et al,, PRINCIPLES OF UNIT OPERATIONS, John Wiley & Sons, New York, 1980.

The integration of aeronautical systems and avionics

ID: PhD-3276
teaching professor: Stupar N. Slobodan
ECTS credits: 5

goals

Modern aircrafts are extremely complex products comprised of many subsystems, components and parts. It is the integration of these components and their interaction and interconnection that determine the overall success of aircraft. The goal of this course is to:

- introduce students with the features of modern aircraft systems
- deepen their knowledge of major aircraft systems: flight control systems, engine and fuel control systems, hydraulic and pneumatic systems, electrical systems, environmental systems...
- introduce students to the emerging new systems and systems under development
- introduce students to the system design and development with emphasis on commercial and military aircraft examples
- investigate current-day avionics and features of modular integrated full glass cockpits.

learning outcomes

By successfully adopting the curriculum, a student:
- acquires fundamental understanding of systems engineering and architecture.
- have a working knowledge related to integrating an aircraft as a system.
- will acquire relevant experience in applying systems engineering concepts, processes and methodologies in the context of aircraft engineering.
-will gain insight into developing technologies and future trends in aircraft systems

theoretical teaching

-Introduction to systems engineering and development
-Flight control systems
-Engine and fuel control systems
-Hydraulic and pneumatic systems
-Electrical systems
-Environmental systems
-Advanced and developing aircraft systems
-Integration of aircraft systems: methodologies and tools used for integration of aircraft systems in order to deliver system that meets user requirements

practical teaching

Contents of lab exercises follow the exposed material. Students will be introduced to examples from industry and the practical problems in the development and integration of individual systems. Through modeling of specific components of the system students master the skills necessary to work in the field of aircraft system engineering. Introducing students to the relevant regulations, standards and methods of aircraft system engineering they are prepared for work in the profession.

prerequisite

There is no necessary requirement for attendance of The integration of aeronautical systems and avionics.

learning resources

Simlab - computer laboratory

number of hours

lectures: 35
research: 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

Moir I., Seabridge A.,Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration
Selected conference papers and research articles
Additional materials (written handouts, problem setting, guidelines for problem solving...)

Theory and Simulation of the Machining Process

ID: PhD-3283
teaching professor: Tanović M. Ljubodrag
ECTS credits: 5

goals

Theoretical considerations of the machining process and its phenomena, establishing its regularities as a prerequisite for solving problems of manufacturing engineering. Establishing the logic of theoretical modeling of machining real physical processes and development of program support for animation and simulation.

learning outcomes

The student should acquire knowledge and develop skills needed for advanced critical and self-critical approach to Theory and Simulation of the Machining Process.
Solving of concrete problems by using scientific methods and procedures.

theoretical teaching

Basics of the machining process theory, Basic elements of the machining process, Material properties, Engineering materials, technology of powder metallurgy, Basics of shaping by plastic deformation, Software development for simulation and animation: cutting resistance in turning, drilling, boring, peripheral and face milling, heat in the cutting zone, grinding process, surface roughness, optimization of the turning and milling processes, machining process dynamics, Special processes and technologies.

practical teaching

Practical teaching involves laboratory work in Laboratory for machine tools and machining systems, and seminar work writing. Planned experiments are carried out in the Laboratory with finishing the reports. These reports are a part of the seminar work.

prerequisite

MSc degree, preferably in technical sciences.

learning resources

Laboratory machines: lathe, planer, radial drill, milling machine, Pfauter milling machine, grinding machine, machining centers, presses, robots, laboratory for FTS, machining processes and tools .

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

Kalpakjian S., Manufacturing Engineering and Technology , Addison-Wesley Pub.Com.,1995
Schey A. John , Introduction Manufacturing Processes, University of Waterloo, Ontario, 2000.
Konig W., Fertingungsverfahren Band 1 – Drehen, Frasen, Bohren, VDI Verlag,1990.
Tanović Lj., Petrakov Y.V., Theory and Simulation of the Machining Process, FME, Belgrade, 2007
Groover P.Mikell, Fundamentals of Modern Manufacturing, Jonh Wiley & Sons, 2002

Theory of elasticity

ID: PhD-3067
teaching professor: Dunjić M. Momčilo
ECTS credits: 5

goals

The goal of this course is that students learn and understand the concepts of the theory of elasticity and the tensor method. Students will be trained to modelise and solve some rheological problems. Through understanding the rheology process they will be able to use computer programs in this field.

learning outcomes

By completing this program students will learn the methods and procedures of contempruery scientific research, introduce the concepts of the theory of elasticity, will be able to solve some concrete problems by the application of modern scientific methods, will be able to relate and apply the acquired knowledge in different areas.

theoretical teaching

Introduction. Elasticity, stress. Stress components (Cartesian system, the cylindrical system). Hooke law. Methods of solving differential equations of equilibrium. Application of trigonometric orders. Principal stresses. Saint-Venan problem. Axial strain. Torsion. Problem of bending. Plane state of stress (stress, strain at point). Contour conditions. Theory of plates and shells. Compatibility equations. The stress function. Plane state of strain.

practical teaching

Determination of the stress components on the basis of balance equations. Stresses in inclined planes. Principal stresses. Engineering examples: axial strain with bending. Strain of rotating disk.

prerequisite

Set by Curriculum of the study program

learning resources

Handouts from the website of the Department

number of hours

lectures: 35
research: 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: 40; project design: 0; final exam: 50; requirements to take the exam (number of points): 40

references

The theory of elasticity, T. Atanacković
The theory of elasticity, S. Tymoshenko, J. N. Gudier
Set of structural strength, T. Maneski, V. Milosevic-Mitic, D. Ostric

Theory of gyroscopes

ID: PhD-3095
teaching professor: Jeremić M. Olivera
ECTS credits: 5

goals

-to provide students knowledge of the fundamental principles and methods in Theory of gyroscopes
-to enable students to solve practical problems in engineering using acquired knowledge in Dynamics of variable mass systems
-to prepare students to monitoring novelties in science and engineering

learning outcomes

-to enable students to master terms, methods and principles in Theory of gyroscopes
-to enable students to relate the knowledge from Dynamics of variable mass systems with knowledge in other scientific fields, to apply knowledge from Dynamics of variable mass systems in analysis, synthesis and prediction of solutions and consequences of problems in science

theoretical teaching

Dynamics of a rigid body rotating about a fixed point. Approximate theory of symmetrical, rapidly spinning gyroscope. Gyroscopic moment. Case of regular precession of symmetrical gyroscope. Fast and slow precession. Examples from technical practice. Differential equations of rotation for symmetrical gyroscope. Gyroscopes with three degrees of freedom. Disturbance of stability of the axis of rapidly spinning gyroscope in the case of restraining its degrees of freedom. Pseudo-regular precession under the action of constant moment under the action of gravitational forces. Differential equations of motion for symmetrical gyroscope. Determination of angle of nutation. Case of rapidly spinning gyroscope. Frictional force action on the motion of the axis of gyroscope. Gyroscope in a Cardan’s suspension. The gyrocompass. The gyroscopic stabilizers.

practical teaching

Dynamics of a rigid body rotating about a fixed point. Approximate theory of symmetrical, rapidly spinning gyroscope. Gyroscopic moment. Case of regular precession of symmetrical gyroscope. Fast and slow precession. Examples from technical practice. Differential equations of rotation for symmetrical gyroscope. Gyroscopes with three degrees of freedom. Disturbance of stability of the axis of rapidly spinning gyroscope in the case of restraining its degrees of freedom. Pseudo-regular precession under the action of constant moment under the action of gravitational forces. Differential equations of motion for symmetrical gyroscope. Determination of angle of nutation. Case of rapidly spinning gyroscope. Frictional force action on the motion of the axis of gyroscope. Gyroscope in a Cardan’s suspension. The gyrocompass. The gyroscopic stabilizers.

prerequisite

Defined by the curriculum study of Phd studies program.

learning resources

Nikolay E.; Theory of Gyroscopes, Gostehizdat, 1948.

Nikolay E.; Gyroscope and its Technical Application, 1947.
Luntz J.; Introduction to Theory of Gyroscopes, Nauka, Moscow, 1972.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 30

references

Nikolay E.; Theory of Gyroscopes, Gostehizdat, 1948.
Nikolay E.; Gyroscope and its Technical Application, 1947.
Luntz J.; Introduction to Theory of Gyroscopes, Nauka, Moscow, 1972.

Theory of Probability and its applications

ID: PhD-3006
teaching professor: Aranđelović D. Ivan
ECTS credits: 5

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. Analysis of variance. Planning of statistical experiment. Random numbers. Monte-Carlo method. Random variables modelling. Technical systems simulation.

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. Analysis of variance. Planning of statistical experiment. Random numbers. Monte-Carlo method. Random variables modelling. Technical systems simulation.

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

lectures: 35

research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 0

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.

Thermal Power Plant Engineering

ID: PhD-3388
teaching professor: Petrović V. Milan
ECTS credits: 5

goals

1. The achievement of research and expert competence in the field of thermal power engineering.
2. The achievement of high level of theoretical knowledge
3. The acquisition of research and expert knowledge in thermal power engineering
4. The achievement of the techniques of process modeling.
5. Mastering the methods of experimental work in thermal power engineering.

learning outcomes

1. Expert and research deep knowledge in thermal power engineering
2. The development of critical thinking about energy use, fuel efficiency and environmental preservation
3. The ability to design of the steam turbine power plants.
4. Ability to use computer technology for modeling and calculations

theoretical teaching

Power Plant Thermodynamic Cycles. Steam Turbine Systems. Condensers. Cooling System Design. Optimization of the steam turbine cold end in power plants. Design and optimization of the feed water heating system. Selection of site for fossil fuel fired power plant. Measurements in power plants. Test of steam turbine and gas turbine power plants. Ecological aspects of power generation. Cogeneration.

practical teaching

Model and software development

prerequisite

PhD student - Thermal power engineering.

learning resources

Literature. Computing facilities

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Petrovic, M: gas turbines and Turbocompressors, scrip, 2004.
Stojanovic, Themal Turbomachinery, Gradjevinska knjiga, Belgrade, 1967.
A.Bejan, G. Tsatsaronis, M. Moran: Thermal Design and Optimization, Wiley, 1996.
K.W.Li, A.P. Proddy: Power Plant System Design, Wiley, 19985
A. Bejan, Advanced Engineering Thermodynamics, 3rd ed., Wiley, 2006.

Thermodynamics Chemical process

ID: PhD-3103
teaching professor: Komatina S. Mirko
ECTS credits: 5

goals

Application of the basic thermodynamic principles on the chemical reactor processes. Reactors with fluidized and with circulating fluidized bed. Connecting the issues of chemical processes thermodynamics with the issues of heat and mass transfer, and fuid flow. Combustion thermodynamics, chemical balance, Gibbs free energy.

learning outcomes

Students are being made capable to conduct theoretical and experimental research of the thermodynamic processes in different types of chemical reactors.

theoretical teaching

Chemical reactors – example of the fluidized bed. Thermodynamic analysis of chemical reactions, free energy and free enthalpy. Chemical reactions kinetics. Chemical reactions mass balance. Chemical reactions energy balance. Application of the basic thermodynamic principles on the chemical reactions. Calculation of chemical reactions during combustion and coal, as well as biomass gasification in the fluidized bed. Calculation of chemical reactions during direct iron ore reduction in the fluidized bed.

practical teaching

prerequisite

learning resources

number of hours

lectures: 35
research: 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: 50; project design: 10; final exam: 40; requirements to take the exam (number of points): 0

references

Kunii & Levenspiel, Fluidization Engineering, 2nd Edition, Butterworth-Heinemann,1991
Moore Nj., Physical Chemistry, Belgrade 1975.
Oka S. N., Fluidized Bed Combustion, M. Dekker, New York. 2004
Komatina M., Heat Transfer between a Single Coal Particle and Hot Fluidized Bed, Faculty of Mechanical Engineering, University of Belgrade, ISBN 978-86-7083-614-3, 2007
Perry's Chemical Engineers' Handbook (7th Edition), Edited by: Perry, R.H.; Green, D.W., McGraw- Hill, 1997

Thermodynamics of complex systems

ID: PhD-3042
teaching professor: Gojak D. Milan
ECTS credits: 5

goals

Acquiring knowledge, mastering the methods of analysis and training for independent work in the field of thermodynamics of complex (multicomponent, multiphase and chemical) systems.

learning outcomes

Capability for independent professional and research work and monitoring developments in the field of thermodynamics of complex systems.

theoretical teaching

Thermodynamic equilibrium – general terms, number of degrees of freedom, rule of phases. Characteristic thermodynamic functions, chemical potential, fugacity, activity. Ideal and real solutions. Conditions of thermodynamic equilibrium in multiphase and multicomponent systems. Thermodynamic characteristics of various multiphase and multicomponent systems, property diagrams. Mixing and heat of mixing, properties of multicomponent systems, partial molar quantities. Driving force in the process of substance transport. Balance of matter in chemical reactions, chemical equilibrium, equilibrium constant of chemical reaction. Application of thermodynamics laws to chemical reactions. Analysis of the conditions of chemical equilibrium and equilibrium shifting under the effect of influencing quantities.

practical teaching

prerequisite

Passed exam in thermodynamics at lower levels of study.

learning resources

number of hours

lectures: 35
research: 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: 40; project design: 0; final exam: 60; requirements to take the exam (number of points): 0

references

S. Gleston: Textbook of physical chemistry, Naucna knjiga, Belgrade, 1970. (In Serbian)
W. Moore: Physical chemistry, Prosveta, Belgrade, 1975. (In Serbian)
D. Voronjec: Basic of process chemistry, Faculty of mechanical engineering, Belgrade, 1989. (In Serbian)
B. Djordjevic, V. Valent, S. Serbanovic: Thermodynamics with thermotehnics, Faculty if technology and metallurgy, Belgrade, 1997. (In Serbian)
B. Jacimovic, S. Genic: Diffusion operation equipment − basic of mass transport , Faculty of mechanical engineering, Belgrade, 2007. (In Serbian)

Thermoelasticity

ID: PhD-3163
teaching professor: Milošević Mitić O. Vesna
ECTS credits: 5

goals

The goal of this course is that students understand the nature of thermal load, to learn the basic terms of thermoelasticity and the tensor way of describing the problem. Students will be trained to model and solve some problems of thermoelasticity. Since many of machine constructions have designed based on beams and plates, special attention will be done on the elements of this form. Through understanding the thermoelastic processes, students will be able to properly use computer programs in this field.

learning outcomes

By completing the program of this course, students will learn some of the methods and procedures of scientific research. They will introduce concepts of thermoelasticity, such as the balance of energy and entropy, the stress and strain tensor. Students will be able to solve some specific problems by using modern analytical methods and numerical methods. They will be introduced with the importance of the construction geometry and the appropriate boundary conditions on the construction behavior. They will be able to relate and apply the acquired knowledge from different areas.

theoretical teaching

Introduction. Stress components in the Cartesian coordinate system. Stress tensor. Displacement equations, compatibility equations, equations of equilibrium. Energy balance. Entropy balance. Free energy. Constitutive relations. The coefficients of elasticity. Lame's constants. Generalized equation of heat conduction. The system of equations of the coupled dynamic thermoelastic problem. The boundary conditions, thermal and mechanical. Plane state of stress. Linear theory of thin thermoelastic plates.

practical teaching

Tensor marking method and some basic operations. Integral transform technique, finite Fourier transform and the Laplace transform. Plain state of stress and plain state of strain. Thermally loaded beams and thin plates. Application of analytical and numerical methods on solving problems of thermoelasticity.

prerequisite

Set by the Curriculum of the study program

learning resources

Handouts from the website of the Department for Strength of constructions

number of hours

lectures: 35
research: 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: 40; project design: 0; final exam: 50; requirements to take the exam (number of points): 40

references

Čukić R., Naerlović-Veljković N., Šumarac D., Thermoelasticity, Faculty of Mechanical Engineering, University of Belgrade
Čukić R., Solutions of some problems of thermoelasticity using integral transform technique, Scientific book, Belgrade
Nowacki W., Dynamic Problems of Thermoelasticity, P. W. N. Warszaw

Thin-walled structures

ID: PhD-3160
teaching professor: Milovančević Đ. Milorad
ECTS credits: 5

goals

The aim of the course is that in the first step, students learn about the problem of torsion of prismatic structural elements of arbitrary shapes and cross-sections, and then with thun-walled structural elements of open and closed cross-sections. Also introduce students to the basics of the theory of thin plates with the problem of losing their stability.

learning outcomes

By mastering the program, students acquire the following general and subject-specific skills: Mastery of methods and thoroughly acquainted with the appropriate expertise. Learning to solve particular problems with the use of scientific methods and procedures, and connects to the acquired knowledge in different areas.

theoretical teaching

Introductory explanations. Torsion bars of arbitrary cross-section. Shear stress. Angle of twist. Out of plane deformation of cross-section. Compound arbitrary cross-section. The rectangular cross-section. Thin rectangular cross-section. Membrane analogy. Basic Theory of thin-walled structural elements. Unconstrained and constrained torsion. Thin-walled open cross-sections. Stresses and strains in unconstrained torsion. The concept of sectoral coordinates. Sectoral geometric characteristics of the cross-section. Main sector coordinators. Shear center. Constrained torsion. Bimoment. Stresses and strains in constrained torsion. Differential equations of the angle of twist. The general case of stress. Thin-walled elements closed cross-sections. Celled sections. Multicellular sections. Bending of compressed beams. Exact solution. Approximate solution. Beam with initial deflection. Bending of thin plates. Differential equations of thin plate bent. Different contour conditions. Thin rectangular plate. Arbitrary load.

practical teaching

Calculation of torsional characteristics of arbitrary and thin-walled cross-sections, the determination of the relevant geometrical properties of the considered cross-sections. Determination of the stress and strain for the cross-sections discussed in the theoretical teaching.

prerequisite

There are no conditions.

learning resources

Handouts from the website of the Department; D.Ružić, R.Čukić, M.Dunjić, M. Milovancevic N. Andjelic V. Milosevic Mitic: Tables of Strength of Materials:; Dobroslav Ruzic: Strength of Constructions

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Thin-walled structures

ID: PhD-3004
teaching professor: Anđelić M. Nina
ECTS credits: 5

goals

The aim of the course is that in the first step, students learn about the problem of torsion of prismatic structural elements of arbitrary shapes and cross-sections, and then with thun-walled structural elements of open and closed cross-sections. Also introduce students to the basics of the theory of thin plates with the problem of losing their stability.

learning outcomes

By mastering the program, students acquire the following general and subject-specific skills: Mastery of methods and thoroughly acquainted with the appropriate expertise. Learning to solve particular problems with the use of scientific methods and procedures, and connects to the acquired knowledge in different areas.

theoretical teaching

Introductory explanations. Torsion bars of arbitrary cross-section. Shear stress. Angle of twist. Out of plane deformation of cross-section. Compound arbitrary cross-section. The rectangular cross-section. Thin rectangular cross-section. Membrane analogy. Basic Theory of thin-walled structural elements. Unconstrained and constrained torsion. Thin-walled open cross-sections. Stresses and strains in unconstrained torsion. The concept of sectoral coordinates. Sectoral geometric characteristics of the cross-section. Main sector coordinators. Shear center. Constrained torsion. Bimoment. Stresses and strains in constrained torsion. Differential equations of the angle of twist. The general case of stress. Thin-walled elements closed cross-sections. Celled sections. Multicellular sections. Bending of compressed beams. Exact solution. Approximate solution. Beam with initial deflection. Bending of thin plates. Differential equations of thin plate bent. Different contour conditions. Thin rectangular plate. Arbitrary load.

practical teaching

Calculation of torsional characteristics of arbitrary and thin-walled cross-sections, the determination of the relevant geometrical properties of the considered cross-sections. Determination of the stress and strain for the cross-sections discussed in the theoretical teaching.

prerequisite

Set by the Curriculum of the study program.

learning resources

1.Handouts from the website of the Department.

number of hours

lectures: 35
research: 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: 40; project design: 0; final exam: 50; requirements to take the exam (number of points): 40

references

D. Ružić, R. Čukić, M. Dunjić, M. Milovančević, N. Anđelić, V. Milošević-Mitić: Strength of matherials-Tables
Dobroslav Ružić: Strength of Constructions

Thrust Vector Control Systems

ID: PhD-3378
teaching professor: Miloš V. Marko
ECTS credits: 5

goals

Acquisition of specific knowledge of the Thrust Vector Control (TVC) systems applied to the solid propellant rockets and liquid propellant rockets.
Objective of the course is providing insight in the physics of the nozzle flow and solutions to provide directional control of missiles, spacecraft and launch vehicles.

learning outcomes

Engineers will be able to make proper selection of the vehicle flight-control system that must perform two functions: fly the vehicle along a commanded trajectory & maintain vehicle flight stability in the atmosphere.
Gained knowledge will be sufficient for initial design of various types of TVC systems.

theoretical teaching

1. Nozzle – different configurations
2. Nozzle – processes inside
3. Nozzle – CFD & Engineering solutions
4. Nozzle – case study
5. Missile Flight Control Systems
6. Classification of TVC systems
7. TVC - Criteria for Comparison
8. Jet Vane, Jetavator, Axial Jet Deflector & Beveled Nozzle Concept
9. Dome Deflector, Jet Tab
10. Impulse Winglet in Rocket Motor Efflux
11. Gimbaled LRE
12. Fundamentals of Actuating Sustems
13. Secondary Fluid Injection
14. Movable Nozzle TVC System - Split Line Classification, Classification Due to the Pivot Point
15. Movable Nozzle TVC System - Classification Due to the Position of Hinge Line, Classification Due to the Type of Nozzle Joint Assembly
16. Stress Analysis & Selection of Materials
17. Testing & verification of TVC Systems
18. TVC– case study

practical teaching

Exercises include presentation of gimbaled LRE TVC system and actuator systems.
Upon completion of calculation and simulation - practical work with TVC system and actuator: measurement of certain parameters and presentation of control.
Also, visiting to:
1. Military Technical Institute – Solid Propelant Rocket Motor Laboratory
2. Department of Automatic Control of Faculty of Mechanical Engineering.

prerequisite

Using of MATLAB® i Simulink®.
Using of CFD software (any).

Using of 3D CAD design software (any) – preferable, not obligatory

learning resources

Moodle (Modular Object-Oriented Dynamic Learning Environment , a free, open-source PHP web application for producing modular internet-based courses that support a modern social constructionist pedagogy).
Lectures, power point presentations, romm equipped with computers & software for design and simulations, labs, handouts.

number of hours

lectures: 35
research: 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: 0; project design: 100; final exam: 0; requirements to take the exam (number of points): 0

references

1. M.Milos, Z.Stefanovic, Thrust Vector Control Systems, professor's handouts

Topics on ship hydromechanics

ID: PhD-3227
teaching professor: Radojčić V. Dejan
ECTS credits: 5

goals

Higher level of ship hydrodynamics. Enablig the candidate to form the mathematical models applicable in ship hydrodynamics.

learning outcomes

More detailed and deeper knowledge of ship hydrodynamics

theoretical teaching

Contemporary methods for evaluation of ship resistance and some propulsive characteristics

practical teaching

Evaluation of ship resistance, propulsive coefficients and detrmination of ship propeller or other ship propulsor.

prerequisite

Defended project

learning resources

The Internet resources, books, and professional magazines

number of hours

lectures: 35
research: 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: 0; project design: 100; final exam: 0; requirements to take the exam (number of points): 100

references

V. Lewis, Principles of Naval Architecture, Resistance and Propulsion SNAME
Sv. harvald, Resistance and Propulsion of Ships
J. Carlton, Marine Propellers and Propulsion

Total Quality Management (TQM)

ID: PhD-3143
teaching professor: Majstorović D. Vidosav
ECTS credits: 5

goals

Detailed study of the business excellence model as an advanced quality management. Establishing a knowledge of the practical application of total quality management model. Developing the ability to assess existing business systems in terms of operational excellence - to improve the existing model of quality management.

learning outcomes

After completion of the teaching process, students will have the necessary knowledge for understanding, researching and resolving problems related to modern approaches to total quality management (TQM) and models of business excellence (BE) based system approach to the business and technology systems. Knowledge of this subject will also enable students to define, investigate and solve modern problems in the field of TQM and BE.

theoretical teaching

Advanced models of quality management, business development Generations of Excellence; Principles of Excellence, American, Japanese and European model of business excellence. The main criteria, sub-criteria; Model
self-assessment; RADAR model, design and application of models of excellence for the organization; VDM model of excellence. Its application. Research excellence model.

practical teaching

Analysis and synthesis of development models of TQM and BE. Research models in this field. Analysis of good practice in TQM and BE.

prerequisite

Faculty degree, primarily technical.

learning resources

1. Lectures for each lesson in electronic form (handouts).
2. Textbook of Total Quality Management (forthcoming).
3. Website to material objects under 1 includes a bibliography of reference books and magazines, leading organizations and major institutions in this area.
4. Technical base case - Laboratory for Production Metrology and TQM, which has the necessary equipment and licensed software for training in this subject.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

of points): 30

references

Wiele, T., Advanced Quality Management, Springer Verlag, London, 2009.
Okland, N., Total Quality Management, Springer Verlag, London, 2009.
Majstorovic, V., A model of Total Quality Management, Mechanical Engineering, Belgrade, 2008.

Transport Phenomena and Analogies

ID: PhD-3041
teaching professor: Gojak D. Milan
ECTS credits: 5

goals

Getting to know with the general models of transport of matter, momentum and heat, mastering the methods of analysis and training for independent scientific work and solving real engineering problems.

learning outcomes

Capability for independent research and monitoring developments in the field of transport of matter, momentum and heat as well as mastering appropriate calculation procedures.

theoretical teaching

Molecular transport, laws of molecular transport – analogies between transport of matter, momentum and heat. Steady and unsteady heat and mass transport, proper dimensionless criteria. Convective transport, differential equations of balance of mass, momentum and energy. Laminar and turbulent, internal and external flow. Velocity, temperature and concentration boundary layer. Coefficients of friction, heat and mass transport – dependencies on the proper dimensionless criteria. Review of the most significant analogies of matter, momentum and heat transport in turbulent flow (Reynolds, Prandtl-Taylor, von Karman, Martinelli, Chilton-Colburn et al).

practical teaching

prerequisite

Passed exams at lower levels of study in fluid mechanics, heat transport and transport phenomena.

learning resources

number of hours

lectures: 35
research: 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: 40; project design: 0; final exam: 60; requirements to take the exam (number of points): 0

references

Diran Basmadjian, Mass Transger – Principles and Applications, CRC Pres, 2003.
A. Bejan, A. Kraus, Heat Transfer Handbook, John Wiley & Sons, 2003.
Y. A. Cengel, Heat transfer – A Practical Approach, McGraw-Hill, 2003.
Incropera, DeWitt, Bergman, Lavine, Fundamentals of Heat and Mass Transfer, J. Wiley & Sons, 2004.
Bennet, C. O., Myers, J. E., Momentum Heat and Mass Transfer, McGraw Hill, 1982.

Tribology of machine elements

ID: PhD-3148
teaching professor: Marinković B. Aleksandar
ECTS credits: 5

goals

To familiarize PhD engineering students with basic concepts of tribology, this would be useful in explaining and enhancing main processes and performances of various machine elements. An objective of the course is to present students crucial need and necessity of taking tribological aspects in design process of machine elements, mechanical systems development and for design in general. Introducing in methodology, procedures and requested tools in aim to organize and conduct corresponding tribology experimental investigations on some typical machine elements.

learning outcomes

Students who are attending to finish this course shall determine the general tribological phenomena and their application in the operation of typical machine elements. In accordance with the available equipment and facilities in laboratory they will introduce methods, types and elements needed for the implementation of the experimental research of machine elements, with emphasis on the creation of data acquisition using NI SCC module and transmitted the necessary software for data acquisition.

theoretical teaching

Introduction, of course, and summarize the basic concepts and phenomena in the field of tribology. The reasons for the necessity of consideration of tribological phenomena in the research and development of individual machine elements and systems. Introduction to Tribological Failure Analysis, Wear Analysis Process with Wear Mechanisms, Surface Examination and Characterisation, Contact Mechanics, Roughness, hardness, friction, Wear Testing; Properties of Lubricants; Lubrication Regimes with analysis; Design of Machine elements from aspect of Lubricants; Hydrodynamic Lubrication (Reynold’s Equation, Fluid and Pad Bearings, Plain Journal Bearings), Elasto-hydrodynamic Lubrication; Design requirements of ceramic and composite sliding contacts, wear and friction behaviour of alumina composites with silicon carbide and graphite as solid lubricants.

practical teaching

Introductory lesson. The concept of training on the subject. Getting to know the Machine design Department lab for mechanical elements investigation with the available equipment and the acquisition of data for experimental research. Types of equipment for data acquisition with the necessary elements. Dating with portable data acquisition system (NI SCC). Demonstration and practice of measuring temperature, stress and strain of machine elements.

prerequisite

should be useful in case of previous finishing course "Experiments and simulations" at MSc studies at group for Design in mechanical engineering (DUM)

learning resources

available literature in form of books and International tribology conferences Proceedings, such as testing machines in laboratory for Machine elements (self lubricating sliding bearings, rolling bearings and gears)

number of hours

lectures: 35
research: 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: 80; project design: 0; final exam: 20; requirements to take the exam (number of points): 50

references

Tribological Design of Machine Elements; D. Dowson, C.M. Taylor, M. Godet , D. Berthe
Tribology by I Hutchings, Edward Arnold
Engineering Tribology by Stachowiak & Batchelor, Butterworth-Heinnemann
Proceedings from International Conferences in tribology (WTC, ECOTRIB, Tribology Colloquium...)

Turbomachinery Flow Phenomena - Computational Fluid Dynamics

ID: PhD-3193
teaching professor: Nedeljković S. Miloš
ECTS credits: 5

goals

Mastering calculation methods for the prediction of flow through complex turbomachinery geometries.

learning outcomes

Mastering calculation methods for the prediction of flow through complex turbomachinery geometries.

theoretical teaching

Three-dimensional non-viscous cascade flow – methods for solution in meridional section, blade-to-blade solution methods, sombined solutions, numerical solution of Euler equations system. Three-dimensional quasi-viscous calculations – application of boundary layer theory, secondary flow and vorticity, combined vorticity model, correction taking in account the losses. Calculation of spatial viscous flow in cascades – turbulent modeling, implicit and explicit procedures, pressure correction methods, artificial compressibility method.

practical teaching

prerequisite

Knowledge of turbomachinery advanced courses, numerical methods, algorithms and programming.

learning resources

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Lakshminarayana B. Fluid Dynamics and Heat Transfer of Turbomachinery. John Wiley & Sons Inc., New York, 1996.
Fletcher CAJ. Computational Techniques for Fluid Dynamics I and II. Springer-Verlag, Berlin 1991

Turbomachinery Flow Phenomena - Design of Cascades and Impeller Blades

ID: PhD-3194
teaching professor: Nedeljković S. Miloš
ECTS credits: 5

goals

Mastering calculation methods of turbomachinery design.

learning outcomes

Mastering calculation methods of turbomachinery design.

theoretical teaching

One-dimensional (line) calculations – lifting surfaces and Wienig0Eckert methods for axial cascades, calculation of circular (radial) cascades. Non-viscous two-dimensional calculation theories – conformal mapping (complex potential, transformation, calculation), panel method, method of singularities, velocity hodograph.

practical teaching

prerequisite

Knowledge of turbomachinery advanced courses, numerical methods, algorithms and programming.

learning resources

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Степанов ГО. Гидродинамика решеток турбомашин. Физматгиз, Москва, 1962.
Dixon Sl. Fluid Mechanics, Thermodynamics of Tubomachinery. 3rd ed. Pergamon Press, Oxford, 1978.

Turbulent flows

ID: PhD-3309
teaching professor: Čantrak M. Svetislav
ECTS credits: 5

goals

learning outcomes

theoretical teaching

THE DYNAMICS OF TURBULENCE: Reynolds equations. Kinetic energy of the mean flow and turbulence. Vorticity dynamics. Reynolds stress and vorticity. The vorticity equation. Vorticity in turbulent flows; The dynamics of temperature fluctuations. Turbulent heat transfer. Reynolds analogy. The mixing – length model; SPECTRAL DYNAMICS AND CORRELATION TENSORS: Correlation functions and spectra. Isotropic turbulence. Statistical description of turbulence. Probability density function. Correlation functions. Energy spectra. Energy cascade; STRUCTURE OF COMPLEX TURBULENT SHEAR FLOW: Turbulent transport. Wall flows. Free flows. Interaction of flows; TURBULENT SHEAR FLOWS: The role of coherent structures in modeling turbulence and mixing; WALL-BOUNDED SHEAR FLOWS: Statistical properties of turbulent swirling flows in pipes and diffusers. Mechanism of turbulent transport processes. Boundary layer turbulence structure. FLOW IN ROTATING FLUIDS. NON-NEWTONIAN FLOWS: Basic and constitutive equations.

practical teaching

prerequisite

learning resources

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Vehicle Logistics

ID: PhD-3062
teaching professor: Duboka V. Čedomir
ECTS credits: 5

goals

Student will be educated, trained and qualified to apply methods of Logistics Engineering in after sales activities related to motor vehicles, which primarily apply to vehicle maintenance and Quality of Service in order to define CSI - Customer Satisfaction Index.

learning outcomes

General:
- analyze, synthesize, solution prediction, consequence estimation
- acquiring research methods, procedures and processes
- development of critical and self-critical approach and approach
- application of knowledge in practice
- professional ethics.

Subject - specific:
- acquiring knowledge in teaching area (T/A)
- knowing and understanding of T/A and profession
- resolution to T/A practical problems
- synergy of knowledge fro different T/A
- follow-up and application of professional novelties
- T/A knowledge application
- application of ICT in T/A

theoretical teaching

Organized in blocks depending on the candidate's closer interest:
First Block : general knowledge concerning Logistics Engineering and after/sales activities in automotive bussiness.
Second Block : Certification and vehicle type approval
Third Block : Vehicle dependability & Quality of service
Fourth Block : Vehicle maintenance with particular emphasis of maintenance quality and quality of spare parts and their provisioning
Fifth Block : Evaluation of CSI.

practical teaching

Application of theoretically acknowledged knowledge to resolve practical problems with the particular emphasis on maintenance quality, spare part quality, and motor vehicle quality of service (CSI).

prerequisite

none

learning resources

1. Classroom
2. Other author book
3. Foreign language books

4. Other literature
5. IT Hardware & Test hardware
6. IT software & Test Software
7. Vehicle service facility

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Handouts
Internet
Ч. Дубока: Технологије одржавања возила, Машински факултет, Београд. 1992.
Ч. Дубока, Аутосервиси, ЈУМВ, Београд, 1999, 2003, 2008.

Vehicle Mechatronics - Special Chapters

ID: PhD-3217
teaching professor: Popović M. Vladimir
ECTS credits: 5

goals

Course objectives are designed to meet the needs of the 21st Century automotive industry for graduates students with the necessary skills and understanding in mechatronics. Students should be able to deal with a wide range of activities that include researching, designing, developing, and testing of mechatronic systems in motor vehicles.

learning outcomes

Students obtain the following general ability:
 analysis, synthesis and forecasting of solutions and consequences
 mastering the methods, procedures and processes of research,
 application of the acquired knowledge into practice.
Students acquire and subject-specific skills:
 thorough introduction to the vehicle mechatronic systems,
 solving concrete problems by using scientific and engineering methods and procedures,
 development of the skills for the use of knowledge in the field of mechatronics in the vehicle.

theoretical teaching

The four main teaching blocks include the following areas: (a) Introduction to Mechatronics and basic mechatronic systems, (b) the vehicle mechatronic systems - general (control systems and automation, dynamics, sensors, micro-electronics, actuators, the central computer unit), (v) specific characteristics of mechatronic system of the vehicle (braking system, suspension system, power transmission systems, integrated systems of the vehicle) and (g) examples of design of mechatronic systems in vehicles.

practical teaching

prerequisite

learning resources

1. B. Vasic, V. Popovic: Vehicle Mechatronics (at prepress).
2. Complete computer support for laboratory exercises.
3. W.Bolton: Mechatronics, Prentice Hall, London, 2008.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Vehicles Maintenance Management

ID: PhD-3218
teaching professor: Popović M. Vladimir
ECTS credits: 5

goals

Course objectives include the achievement of competencies and academic skills as well as methods for their acquisition, in the field of vehicles maintenance management. The goals arising from basic tasks and determine the specific results that should be realized within the subject and represent the basis for the control of the results achieved.

learning outcomes

Students obtain the following general ability:
- analysis, synthesis and forecasting of solutions and consequences
- mastering the methods, procedures and processes of research,
- application of acquired knowledge into practice.

Students acquire and subject-specific skills:
- thorough introduction to the field of vehicles maintenance management,
- solving concrete problems by using scientific and engineering methods and procedures,
- development of the skills for the use of knowledge in the field of vehicles maintenance management.

theoretical teaching

Five main teaching blocks include the following areas: (a) Introduction to systems (definitions, concepts, process), (b) The process of system design (preliminary and detailed design, development, testing and evaluation), (v) analysis of system and project evaluation (alternatives and models in decision making, models of economic evaluation, optimization techniques in the design of control), (g) designing for reliability, maintainability, usability (human factors), logistic support, and (d) vehicles maintenance management (program planning, organization, control).

practical teaching

prerequisite

learning resources

1. V. Popovic: Vehicles Maintenance Management - handouts.
2. B. Vasic, J.Todorovic, et al.: Maintenance of Technical Systems, Institute for Research and Design in Commerce & Industry, Belgrade, 2006.
3. B. Vasic, V. Popovic: Engineering management metods, Institute for research and design in comerce & industry, Belgrade, 2007.
4. Vasic, B. : Management and Engineering in Maintenance, IIPP, 2004.

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Vehicle Testing - Special Chapiters

ID: PhD-3061
teaching professor: Duboka V. Čedomir
ECTS credits: 5

goals

Student will be educated, trained and qualified to apply methods of experimental work in development, qualification (certification) and verification of road vehicles.
Analogous methods will apply experimental methods used in the specific areas of automotive engineering, depending on the interest of students.

learning outcomes

General:
- analyze, synthesize, solution prediction, consequence estimation
- acquiring research methods, procedures and processes
- development of critical and self-critical approach and approach
- application of knowledge in practice
- professional ethics.
Subject - specific:
- acquiring knowledge in teaching area (T/A)
- knowing and understanding of T/A and profession
- resolution to T/A practical problems
- synergy of knowledge fro different T/A
- follow-up and application of professional novelties
- T/A knowledge application
- application of ICT in T/A

theoretical teaching

Organized in blocks depending on the candidate's closer interest:
First Block : general knowledge concerning experimental work in automotive engineering.
Second Block : Vehicle performance testing
Third Block : Vehicle road load testing
Fourth Block : Vehicle reliability testing
Fifth Block : Vehicle safety testing.

practical teaching

Application of theoretically acknowledged knowledge to resolve practical experimental tasks in the area of PhD thesis of the candidate.

prerequisite

none

learning resources

1. Laboratory
2. Other author book
3. Foreign language books
4. Other literature
5. IT Hardware & Test hardware

6. IT software & Test Software

number of hours

lectures: 35
research: 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: 0; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Handouts
Todorovic J., Ispitivanje motornih vozila, JUMV, 1992
Internet
Test equipment provider documentation

Waste management and research

ID: PhD-3096
teaching professor: Jovović M. Aleksandar
ECTS credits: 5

goals

The aim of this course is introducing the candidates with problems and problem solving in the field of waste management with respective scientific methods; subject is designed as an advanced course in the area of waste management at the level of doctoral studies.

learning outcomes

At the end of the course it is expected that the candidate has mastered the scientific knowledge pertaining to the analysis and evaluation of scientific papers, ways and methods of analysis of certain waste management procedures, laboratory work, as well as advanced process modeling in the area of municipal waste management system, thermal and biological waste treatment, methods of waste depositing and landfill gas generation.

theoretical teaching

Characteristics of the waste materials. Analysis of specific legislation. Theoretical and practical study of the processes of handling, treatment and waste disposal at the source site. Analysis of the processes and equipment for waste separation and possibilities of using waste materials as raw materials and renewable energy sources. Processes and equipment for biological treatment of waste. Processes and equipment for thermal treatment of waste. Disposal of waste. Pollutant emission from the processes and facilities for the removal and utilization of waste. Procedures and equipment for purification of flue gases and wastewater from waste treatment processes. Research and analysis of mathematical models that describe the processes of waste treatment. The study of experimental waste treatment procedures.

practical teaching

If needed laboratory work and visits to industrial facilities.

prerequisite

There is no previous requirements for attending this course.

learning resources

Laboratory facility / installation / machine (LFI):
1. laboratory facility for wastewater treatment research
2. laboratory facility for thermal treatment of waste
and other facilities and installations if needed.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10; test/colloquium: 0; laboratory exercises: 10; calculation tasks: 0; seminar works: 80; project design: 0; final exam: 0; requirements to take the exam (number

of points): 0

references

Tchobanoglous, G., Theisen, H., Vigil, S., Integrated Solid Waste Management, Engineering Principles and Management Issues, McGraw-Hill, 1993, ISBN 0-07-063237-5
. Chang Ho Oh (ed.), Hazardous and Radioactive Waste Treatment Technologies Handbook, The Mechanical Engineering Handbook Series, CRC Press, 2001., ISBN 0-8493-9586-0
Manahan, S.E., Industrial Ecology, Environmental Chemistry and Hazardous Waste, Lewis Publishers, 1999., 1-56670-381-6.
Papers from Journals Waste Management and Research, Waste Management, etc.

Water waves

ID: PhD-3159
teaching professor: Milićev S. Snežana
ECTS credits: 5

goals

The goal of this course is to acquire knowledge about the fundamental aspects of the water wave's phenomena and mastering of mathematical methods for modeling these flows present in a variety of practical problems.

learning outcomes

Students are trained to develop mathematical models of water waves and to solve them by analytical and numerical methods.

theoretical teaching

Theoretical lessons incorporate the basic laws that describe the water wave's phenomenon which includes several specific studies of the problems.

practical teaching

Practical lessons contain application of analytical and numerical results for different models of linear and nonlinear water waves.

prerequisite

Passed exam in Fluid mechanic and Thermodynamics.

learning resources

Course handouts.

number of hours

lectures: 35
research: 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: 50; project design: 0; final exam: 50; requirements to take the exam (number of points): 50

references

A Modern Introduction to the Mathematical Theory of Water Waves, R. S. Johnson, Cambridge University Press, October 28, 1997
Linear Water Waves: A Mathematical Approach, N. Kuznetsov, V. Maz'ya, B. Vainberg, Cambridge University Press; 1 edition (August 19, 2002)

Wave Induced Loads on Ships

ID: PhD-3187
teaching professor: Motok D. Milorad
ECTS credits: 5

goals

Learning basic theory and practical procedures for calculation of wave induced shear forces and bending moments on ship hulls.

learning outcomes

Student should be capable of conducting calculations of wave induced shear forces and bending moments on ship hulls using commercial software tools.

theoretical teaching

Derivation and solving differential equations of Salvesen, Tuck and Faltinsen for cobined heave and pitch - up to values of shear force and bending moment along ship.

practical teaching

Numerical methods for solving differential equations of Salvesen, Tuck and Faltinsen for combined heave and pitch. Getting acquainted with commercial software in the field.

prerequisite

Defined by the curriculum of studies. Successfully finished course in Sea-keeping on doctorial studies.

learning resources

Commercial software in the field.

number of hours

lectures: 35
research: 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

Jorgen Juncher Jensen: Load and Global Response of Ships, Technical University of Denmark, 2000
I. Dyer, R. Eatock Taylor, J.N. Newman, W.G. Price: Sea Loads on Ships and Offshore Structures, Cambridge University Press 1995.

Welded Structures

ID: PhD-3351
teaching professor: Sedmak S. Aleksandar
ECTS credits: 5

goals

This course comprises design and behaviour of welded structures under different types of loadings, including cracked welded joints, both in elastic and elasto-plastic region. Special emphasis is on undermatching and overmatching effects and cracking phenomena. Non-destructive testing, as well as mechanical testing (tensile, impact, fracture mechanics) of welded joint is covered as well. The finite element method is used for stress analysis.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 course 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 in designing welded structures.

theoretical teaching

General introduction to welding technology. Theoretical basics of welded structures. Fundamentals of strength of materials. Thermal processes during welding. Residual stresses. Cracking phenomena (Hot cracking, Lamellar tearing).Metallurgical processes during welding, weldability. Cold-cracking, Reheat cracking).Basics of weld design. Design principles of welded structures. Joint design. Welding stresses and distortion.Behaviour of welded structures under different types of loadings.Intro: quality requirements, allowable defects, standards.Weldment Fracture Mechanics: Linear Elastic & Elastic-Plastic.Weldment Fracture Mechanics:UM, OM, small & large crack. 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

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. Design of welded structures with predominantly static loading. Design of dynamically loaded welded structures. Design and behaviour of welded structures – overview. Design of thermomechanically loaded welded structures. Testing of welded joints Ch6 AWS.Testing of welded joints BS7448. Non-destructive testing in lab. Application of the Finite Element Method.

prerequisite

learning resources

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

[2] Excerpts from the standard
[3] T.L. Anderson, Fracture Mechanics: Fundamentals and Applications 3rd ed. CRC Press, London, 2005.
[4] A. Sedmak, S. Sedmak, LJ. Milović, Pressure eljuipment inegrity assessment bz elastic-plastic fracture mechanics methods, monografija, DIVK, Beograd, 2011.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

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

references

T.L. Anderson, Fracture Mechanics: Fundamentals and Applications, 3rd ed, CRC Press, London, 2005.
Jin Z. H., Sun C.T., Fracture Mechanics, Academic Press, 2011.
Broek D., The Practical Use of Fracture Mechanics, Springer, 1989.
A. Sedmak, S. Sedmak, LJ. Milović, Pressure eljuipment inegrity assessment bz elastic-plastic fracture mechanics methods, monografija, DIVK, Beograd, 2011.

Welding Technology

ID: PhD-3356
teaching professor: Sedmak S. Aleksandar
ECTS credits: 5

goals

This course covers conventional welding processes, focused on MMAW, SMAW, SAW), and special processes like plasma, electron beam and laser welding. All common engineering materials are covered, like structural non-alloyed and low-alloyed steels, thermomechanically treated ferrite steels, stainless steels, non-ferrous alloys. Numerical simulation of welding process, treated as non-linear, non-stationary thermomechancal problem with phase and structural changes, is performed by the finite element methods. Understanding the basic principles of welding processes and technology as a prescribed course of action to be followed when making a weld. Introducing students to techniques of material selection, preparation, preheating, methods and control of welding and subsequent thermal treatment. Understanding and solving exercises in welding technology. Development of an independent paper by creation and presentation of selected seminar papers.

learning outcomes

By attending the course the students are mastering the basic knowledge of welding processes and technology. Theoretical considerations and computational examples enable the student to master all the necessary principles of welding processes needed for the manufacture of welded joints. Introducing students to current modern standards and recommendations in this field.

theoretical teaching

Introduction to basic principles of welding technology. General introduction to welding and joining technology.Defining the prior specification of welding technology (PSWT). Qualification of welding technology (QWT). Specification of welding technology (SWT) - analysis of the document defined by standards, containing information about the manufacturer, the basic material, process and welding position, joint preparation, notch and edges, welding technique, additional material, all welding parameters, preheating temperature and interlayer temperature.Conventional process − electrical − intro & general. MMAW. Structural integrity of weldments. SMAW/TIG. Integrity of Welded Structures. Weldment stress analysis by FEM. High density power (beam, laser). High density power (plasma). Thermal spraying, Surfacing, SAW.Ferritic steels − standard structural C steels, Ferritic steels - Low alloyed. Ferritic steels − Ni alloyed steels (cryo), Creep resistant steels. Ferritic steels − miroalloyed high strength, thermomechanically treated. Austenitic steels, different (austenitic-ferritic...), Ni & alloys Nonferrous − Al, Cu.Qualification of welders - analysis of EN 287-1 standard, which includes the principles on which the qualification testing of professional welders for welding steel by melting is based.

practical teaching

Auditory exercises with examples of welding technology problems. Solving exercises in specification of welding technology - examples include various types and thicknesses of the base metal, welding process and position. Solving exercises in qualification of welding technology - examples include various types and thicknesses of the base metal, welding process and position. Thermal spraying, Surfacing, SAW.Weldment stress analysis by FEM.Simulation of welding process by FEM. The defense and presentation of selected seminar papers.

prerequisite

learning resources

[1] Written lessons from lectures (handouts)
[2] S. Sedmak et al., The Challenge od Materials and Weldments, SSIL, Belgrade, 2008.
[3] Plavšić N., Šijački-Žeravčić V., Stamenić Z.: Tables of mechanical materials, profiles, sheets and wires, Faculty of Mechanical Engineering, Belgrade, 2004;
[4] Excerpts from the standard
[5] AWS, Welding handbook, 9th edition

number of hours

lectures: 35
research: 0

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): 40

references

ID: PhD-3225
teaching professor: Radojević LJ. Slobodan
ECTS credits: 5

goals

The acquisition of basic knowledge of the Theory of computation.

learning outcomes

Upon completion of the course, a PhD student understands the concepts of the Theory of computation. Understand the concept of formal and informal algorithms and concepts decidable and undecidable problems and their role in Computer Science.

theoretical teaching

1. Turing machine.
2. UR machines.
3. Primitive recursive functions, recursive functions.
4. Enumeration, universal functions.
5. Decidability, undecidability, partial decidability.
6. Recursive and recursively нumbered sets.
7. Simplify and degree of speed.
8. Recursion theorem.

practical teaching

Follow theoretical teaching.

prerequisite

Programming and C or C++.

learning resources

Blackboard and chalk.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 0; calculation tasks: 0; seminar works: 45; project design: 0; final exam: 50; requirements to take the exam (number of points): 50

references

N. Cutland: Computability: an introduction to recursive function theory, Cambridge University Press, 1980.

ID: PhD-3398
teaching professor: Radojević LJ. Slobodan
ECTS credits: 5

goals

The course of higher mathematics consists of two parts. The first part is devoted to the study of algebraic structures, from group theory to the vector space. Certain applications in mechanical engineering are presented with eigenvalues and eigenvectors. The second part of the course devoted to partial differential equations. Taught partial equations of first and second order. Applications in mechanical engineering is presented by the equation of heat conduction.

learning outcomes

PhD student will be familiar with the small part and partial linear algebra and partial equations, but will have a basis for further work and applications in mechanical engineering.

theoretical teaching

1. Vectors in R^n and C^n. Linear Equations.
2. Matrices. Groups.
3. Vector spaces and subspaces. Basis and dimension.
4. Eigenvalues and eigenvectors.
5. General concepts of partial differential equations.
6. Partial equations of the first order. Homogeneous linear equations of the first order.
Quasi-linear partial equations of the first order. Lagrange method.
7. Partial equations of second order. Classification of second order linear equations.
One-dimensional wave equation. Two-dimensional wave equation.
8. The equation of heat conduction. Laplace equation.

practical teaching

Auditory tasks and exercises to fully follow the lecture.

prerequisite

Standard mathematics courses.

learning resources

Chalk and blackboard.

number of hours

lectures: 35
research: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5; test/colloquium: 0; laboratory exercises: 0; calculation tasks: 0; seminar works: 45; project design: 0; final exam: 50; requirements to take the exam (number of points): 50

references

ID: PhD-3318
teaching professor: Adžić M. Miroljub
ECTS credits: 5

goals

To familiarize the students with the state-of-the-art combustion technologies and combustion systems.

learning outcomes

Encouragement of the students to apply the state-of-the-art combustion technologies and combustion systems in practice.

theoretical teaching

1. Introduction.
2. New achievements in combustion.
3. Environmental protection.
4. Free space combustion.
5. Fluidized bed combustion.
6. Solid matrix combustion.
7. Flameless combustion.
8. Preparation of fuels.
9. Combustion of non-standard fuels.
10. Modern combustion equipment.
11. Combustion and environmental protection.
12. Optimization of combustion equipment.

practical teaching

prerequisite

learning resources

number of hours

lectures: 35
research: 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: 90; project design: 0; final exam: 0; requirements to take the exam (number of points): 0

references

Handouts