Specification for the book of courses

Study program	Electronics and Microsystems		
Module	Electronics and Microsystems		
Type and level of studies	Master studies		
The name of the course	Adaptive Signal Processing		
Lecturer (for lectures)	Stančić Z. Goran		
Lecturer/associate (for exercises)	Cvetković S. Stevica		
Lecturer/associate (for OFE)	Cvetković S. Stevica		
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	
Course objectives	Acquiring basic knowledge of adaptive processing of digital signals. Introduction to the methods of practical implementation of the adaptive filter transfer function. Introduction to Matlab commands for analyzing and processing of digital signals. □ Theoretical and practical knowledge of the methods for the design of adaptive filters. Mastering the techniques of nonrecursive adaptive filters design.□
Course outcomes	Collecting of theoretical and practical knowledge of the methods for the design of adaptive filters. Mastering the techniques of nonrecursive adaptive filters design.□
Course outline	
Theoretical teaching	Least-squares approximation. Correlation. Discrete Fourier transform. Random signals. Spectral estimation. Power density spectrum. Signal energy. Properties of the power spectrum. Power spectral estimation. Wiener filter. Kalman filter. Least-squares system design. Linear predictor realization. System identification. Channel equalization. Interference canceling. Adaptive notch filters. MSE function. Covariance. Convergence time constants. Ideal condition convergence. Steepest-descent algorithm. LMS algorithm. Modified LMS algorithms. RLS algorithm. Measures of adaptive system performance. Learning curve.□
Practical teaching (exercises, OFE, study and research	Least-squares approximation calculations in Matlab for analog signals. Least-squares approximation calculations in Matlab for digital signals.Orthogonality. The discrete Fourier series. Correlation. Covariance. Realization of linear predictor, system identification, channel equalization and interference canceling in Matlab.□
Textbooks/references	
1	Samuel D. Stearns, Digital signal processing with examples in Matlab, CRC Press Washington, 2003.
2	Ed. Vijay K. Madisetti and Douglas B. Williams, Introduction to Adaptive Filters, Digital Signal Processing Handbook, 1999
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Number of classes of active education per week during semester/trimester/year

Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	2	1		

Teaching methods	Lectures, auditory exercises, consultation□

Grade (maximum number of points 100)

Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures		**Written exam**	30
Exercises		**Oral exam**	40
Colloquia			
Projects	30		

Specification for the book of courses

Study program	Electrical Power Engineering		
Module	Electrical Power Engineering		
Type and level of studies	Master studies		
The name of the course	Methods of optimization		
Lecturer (for lectures)	Marinković D. Slađana		
Lecturer/associate (for exercises)	Jovančić S. Vladan		
Lecturer/associate (for OFE)			
Number of ECTS 5	**Course status (obligatory/elective)**	Elective	

Prerequisites	
Course objectives	Gaining basic mathematical knowledge of optimization and different optimization methods. Developing skills of mathematical modelling of real problems of practice, as well as solving them.
Course outcomes	Students' competence to put the gained knowledge into practice. Competence to identify and define the optimization problems of practice, develop mathematical models, choose the appropriate methods for their solving and the application of methods.
Course outline	
Theoretical teaching	Defining the general optimization problem. Theoretical basis of optimization. Elements of convex analysis. Linear programming. Duality. Simplex method. Nonlinear programming. Unconstrained optimization. Searching methods. Gradient methods. Constrained optimization. Kuhn-Tucker conditions. Lagrange multipliers method. Penalty functions methods. Quadratic programming. Basis of multiobjective optimization. Overview of heuristic methods.
Practical teaching (exercises, OFE, study and research	Exercises of knowledge gained in the lectures. Impementation of optimization algorithms by the appropriate software.
Textbooks/references	
1	Lj. M. Kocić, G. V. Milovanović, S. Marinković, Operational research, University of Niš, Faculty of Electronic Engineering, 2007.(Serbian)
2	G.V. Milovanović, P.S. Stanimirović: Symbolic Implementation of Nonlinear Optimization, University of Niš, Faculty of Electronic Engineering, Niš, 2002 (Serbian).
3	K. Y. Lee and M. A. El-Sharkawi, Modern Heuristic Optimization Techniques: Theory and Applications to Power Systems, Wiley, 2008.
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Number of classes of active education per week during semester/trimester/year

Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	2	0		

Teaching methods	Lectures, exercises consultations.

Grade (maximum number of points 100)

Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures		**Written exam**	40
Exercises		**Oral exam**	20
Colloquia			
Projects	40		

Specification for the book of courses

Study program	Computing and Informatics		
Module	Software Engineering		
Type and level of studies	Master studies		
The name of the course	Geographic Information Systems		
Lecturer (for lectures)	Stojanović H. Dragan, Stojanović M. Natalija		
Lecturer/associate (for exercises)	Predić B. Bratislav		
Lecturer/associate (for OFE)			
Number of ECTS 4	**Course status (obligatory/elective)**	Elective	

Prerequisites	
Course objectives	Acquiring knowledge, methods and technologies required for design and implementation of geographic information systems (GIS).
Course outcomes	Theoretical and practical knowledge about principles, methods, software tools, omponents and frameworks for design and implementation of geographic information systems (GIS).
Course outline	
Theoretical teaching	Introduction to geographic information systems (GIS). Geographic and cartographic foundations of GIS. Architecture and design GIS-a. Methods and systems for positioning. Satellite systems for global positioning - GPS (Global Positioning System). System for positioning based on wireless networks in indoor environment. Geospatial data models. Geospatial data representations and algorithms for processing. Index structures and access methods. Spatial databases. GIS architecture and design. Geo-visualization and GIS interfaces. Methods and algorithms for geospatial data analysis. Time in GIS and spatio-temporal data management. Processing and analysis of Big geospatial data. Specification and standards in geospatial and GIS domains (OGC, ISO TC 211, etc.). Web GIS and distributed GI services. Mobile GIS and location-based services.
Practical teaching (exercises, OFE, study and research	Work on design and implementation of geographic information system using commercial and open source software components, frameworks and platforms. Spatial database design and implementation. Implementation of GIS functionalities for storage, processing, search, analysis, and visualization of geospatial and spatio-temporal data. Implementation of Web GIS applications and Web services based on OGC standards and specifications. Implementation of mobile GIS applications.
Textbooks/references	
1	M. Worboys, M. Duckham, GIS: A Computing perspective, second edition, CRC Press, 2004.
2	P. A. Longley, M. F. Goodchild, D. J. Maguire, D. W. Rhind, Geographic Information Systems and Science, 3rd edition, John Wiley & Sons, 2010.
3	P. Rigaux, M. Scholl, A. Voisard, Spatial Databases: With Application to GIS, Morgan Kaufmann,2002
4	Kang-tsung Chang, Introduction to Geographic Information Systems, 6th Ed, McGraw-Hill Science, 2011
5	

Number of classes of active education per week during semester/trimester/year

Lectures	Exercises	OFE	Study and research work	Other classes
2	1	0		

Teaching methods	Lectures, auditive exercises, lab practicing, independent student work on assignments and projects, student seminars.

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points
Activity during lectures		Written exam	40
Exercises		Oral exam	
Colloquia	40		
Projects	20		

Specification for the book of courses

Study program	Computing and Informatics
Module	Software Engineering
Type and level of studies	Master studies
The name of the course	Computer Animation
Lecturer (for lectures)	Rančić D. Dejan, Milosavljević Lj. Aleksandar
Lecturer/associate (for exercises)	Dimitrijević M. Aleksandar
Lecturer/associate (for OFE)	

Number of ECTS	4	**Course status (obligatory/elective)**	Elective

Prerequisites	
Course	Getting to know basic algorithms and techniques for computer animation.
Course outcomes	Theoretical and practical knowledge of algorithms and techniques for computer animation. Ability to independently develop graphics applications as well as to use ready-made software for computer animation.
Course outline	
Theoretical teaching	Algorithms and programming techniques of computer animation. Algorithms and approaches to behavior animation and animation based on object physics. 2D and 3D animation. Sprites. Key Frame Technique. Animation of the face and mimics. Direct and inverse kinematics. Capture the movement. Animation in video games. Animation of the particle system. Clothing animation.
Practical teaching (exercises, OFE, study and research	Getting acquainted with software tools for computer animation.
Textbooks/references	
1	Rick Parent et al., Computer Animation Complete, Morgan Kaufmman Publ., 2009.
2	Marcia Kuperberg et al., A Guide to Computer Animation for TV, Games, Multimedia and Web, Focal Press, 2002.
3	The Complete Guide to Blender Graphics, Blender 2.50, John M. Blain, CRC Press, 2012.
4	Blender 2.5 Character Animation Cookbook, Blender 2.50, Virgilio Vasconcelos, Packt Publishing, 2011.
5	Introducing Character Animation with Blender 2nd ed, Blender 2.50, Tony Mullen, Sybex, 2011.

Number of classes of active education per week during semester/trimester/year

Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	1	0		

Teaching methods	Lectures, consultations, independent study research.

Grade (maximum number of points 100)

Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures		**Written exam**	
Exercises	30	**Oral exam**	40
Colloquia			
Projects	30		

Specification for the book of courses

Study program	Control Systems		
Module	Automatic Control		
Type and level of studies	Master studies		
The name of the course	Intelligent machines		
Lecturer (for lectures)	Raković M. Mirko		
Lecturer/associate (for exercises)	Sibinović D. Vladimir		
Lecturer/associate (for OFE)			
Number of ECTS 5	**Course status (obligatory/elective)**	Elective	

Prerequisites	
Course objectives	The principles of operation and design of systems that have the inteligence to communicate with the enviromente, especially with humans.
Course outcomes	Understanding the motivations for the design of machines based on the principles of artificial intelligence from the viewpoint of perception, cognition and performance. Organization of intelligent machines, especially mobile robots.
Course outline	
Theoretical teaching	Definitions of intelligent systems and subsystems. Definition of mechanical intelligence. Intelligence in decision-making. Differences between natural systems and machines. Movement and manipulation as the basis for the development of intelligence. Design principle of functional imitation of existing natural solutions. Biomimetics. Functional robustness of mechanical solutions for sake of control simplicity. Intelligent drive as a functional copy of the natural techniques of motion. Actuators with integrated sensors and controllers as the simplest way of control. Methods and techniques of modeling by interactions. Parametric and non-parametric models. Design of controller with the integrated model. Examples of intelligent machines, with an emphasis on walking, grasping, verbal, non-verbal and physical interaction with humans and the environment.
Practical teaching (exercises, OFE, study and research	Solving specific examples and problems during exercises will help students to master methodical units which will be covered through theoretical lectures.
Textbooks/references	
1	Lecture notes and slides (to be posted on the web page of the Faculty)
2	Scientific and technical papers in accordance with student’s needs.
3	
4	
5	

Number of classes of active education per week during semester/trimester/year

Lectures	Exercises	OFE	Study and research work	Other classes
2	2	0		

Teaching methods	Multimedia lectures. Auditory exercise and demonstration.

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points
Activity during lectures	10	Written exam	0
Exercises	0	Oral exam	40
Colloquia	0		
Projects	50		

Specification for the book of courses

Study program		Control Systems		
Module		Automatic Control		
Type and level of studies		Master studies		
The name of the course		Methods of digital control and estimation		
Lecturer (for lectures)		Veselić R. Boban		
Lecturer/associate (for exercises)		Mitić M. Vladimir		
Lecturer/associate (for OFE)				
Number of ECTS	5	**Course status (obligatory/elective)**		Elective
Prerequisites				
Course objectives	Introduce to students some modern approaches to digital control and control plant state estimation.			
Course outcomes	Provide the students with theoretical and practical knowledge needed for the application of modern digital control techniques. Train the students to use computer support in design and simulation of digital control systems.			
Course outline				
Theoretical teaching	Review of the mathematical background and digital systems analysis in z-domain. Linear digital systems frequency response. Bilinear transformation. Bode plots. Digital compensators design in z- and frequency domain. State space approach. Controllability and observability. Canonical state space forms. State feedback control and pole placement method. Ackerman formula. Deadbeat response. State variables estimation. Linear digital state observers and their design. Elements of the theory of stochastic processes. State estimation in uncertain control systems. Kalman filter.			
Practical teaching (exercises, OFE, study and research	Elaboration of methodical units of the lectures through examples with intensive use of MATLAB Control Toolbox as a substantial support in design, simulation and validation of digital control systems.			
Textbooks/references				
1	Katsuhito Ogata, Discrete-Time Control Systems, Second Edition, Prentice-Hall International, 1995.			
2	Gene F. Franklin, J. David Powell, Michael L. Workman, Digital Control of Dynamic Systems, Third Edition, Addison-Wesley, 1997.			
3	Charles L. Phillips, H. Troy Nagle, Digital Control System Analysis and Design, Third Edition, Prentice Hall, 1994.			
4				
5				
Number of classes of active education per week during semester/trimester/year				
Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	2	0		
Teaching methods	Lectures; Auditory and computer exercises; Consultations.			
Grade (maximum number of points 100)				
Pre-exam duties	**Points**	**Final exam**		**Points**
Activity during lectures	10	**Written exam**		20
Exercises	10	**Oral exam**		20
Colloquia	20			
Projects	20			

Specification for the book of courses

Study program	Control Systems		
Module	Automatic Control		
Type and level of studies	Master studies		
The name of the course	Flexible Production Systems		
Lecturer (for lectures)	Jovanović D. Zoran, Nikolić S. Saša		
Lecturer/associate (for exercises)	Todorović Z. Darko		
Lecturer/associate (for OFE)			
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	
Course objectives	Introduction to the production systems and their comparison. Cellular manufacturing systems and their applications. The application of Computer Integrated Manufacturing - CIM, advantages and disadvantages.
Course outcomes	Understanding of manufacturing technologies, their advantages and disadvantages. Ability to track trends in modern production systems. Development of own production techniques and quality control in flexible manufacturing systems.
Course outline	
Theoretical teaching	Introduction to industrial production. What are production lines, methods of production, continuous production, flexible manufacturing systems. Types of flexibility and flexible manufacturing systems. Management of flexible manufacturing systems. Detailed example of a flexible manufacturing system. Production process and reduction of waste. Review on the quality system. Quality assurance and control, tolerance. Standard components, what are they and why use them in the development and manufacture. Complexes of standard components. Development of existing products. Packing, function of packing, packaging materials.
Practical teaching (exercises, OFE, study and research	
Textbooks/references	
1	Lecture notes and slides (to be posted on the web page of the Faculty)
2	Scientific and technical papers in accordance with student's needs.
3	
4	
5	

Number of classes of active education per week during semester/trimester/year

Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	2	0		

Teaching methods	Lectures, board exercises, individual student homework and project, student final papers presentation and discussion.

Grade (maximum number of points 100)

Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures	10	**Written exam**	
Exercises		**Oral exam**	40
Colloquia			
Projects	50		

Specification for the book of courses

Study program	Control Systems		
Module	Automatic Control		
Type and level of studies	Master studies		
The name of the course	Embedded Systems		
Lecturer (for lectures)	Nikolić R. Tatjana		
Lecturer/associate (for exercises)	Nikolić R. Tatjana		
Lecturer/associate (for OFE)			
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	
Course objectives	The aim of this course is to introduce students to the principles of designing embedded systems and the specific problems and requirements that are typical for the main fields of embedded systems application.
Course outcomes	Gaining knowledge about the embedded systems architecture, hardware and software elements, communication mechanisms, programming techniques, embedded operating systems and development environments that are necessary for the development of practical applications.
Course outline	
Theoretical teaching	Definition, characteristics and categories of embedded systems. Integrated hardware and software aspects of the embeded processor architecture. Designing an embeded system using formal models and methods, as a computer-based synthesis method. Architecture (based on modern 32/64-bit embeded processors) and components of embeded systems. Hardware-software interfaces, memory architectures, buses. Embeded operating systems. Concurrentness (software and hardware interrupts, timers). Real-time operation principles (multitasking, task scheduling, synchronization). Device driver development. Designing embeded software (handling exceptions, loading, changing operation mode, embeded programming), implementation and debugging. Profiling and code optimization. Designing an low power embedded system.
Practical teaching (exercises, OFE, study and research	It is planned that students independently do laboratory exercises using modern development environment and development tools for designing embeded systems based on ARM processor with low power and high performance.
Textbooks/references	
1	Embedded systems, PowerPoint presentations for all lectures, available on the website of the course
2	Christopher Hallinan, Embedded Linux Primer, Second Edition, Pearson Education, Inc., 2011.
3	Changyi Gu, Building Embedded Systems, Programmable Hardware, Apress, 2016.
4	Derek Molloy, Exploring Raspberry Pi, Interfacing to the Real World with Embedded Linux, John Wiley & Sons, Inc., 2016.
5	Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufmann, 2008.

Number of classes of active education per week during semester/trimester/year

Lectures	Exercises	OFE	Study and research work	Other classes
2	2	0		

Teaching methods	Lectures, exercises, labs, homeworks, colloquia, projects, consultations

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points
Activity during lectures		**Written exam**	30
Exercises	20	**Oral exam**	30
Colloquia	20		
Projects			

Specification for the book of courses

Study program		Control Systems		
Module		Automatic Control		
Type and level of studies		Master studies		
The name of the course		Control of Large-scale Systems		
Lecturer (for lectures)		Mitić B. Darko, Perić Lj. Staniša		
Lecturer/associate (for exercises)		Milovanović B. Miroslav		
Lecturer/associate (for OFE)				
Number of ECTS	5	**Course status (obligatory/elective)**	Elective	
Prerequisites				
Course objectives	Gaining knowledge of the control of large-scale systems, multivariable systems, centralized and decentralized systems.□			
Course outcomes	Knowledge of control of multivariable dynamical systems with centralized and decentralized information and control structure.			
Course outline				
Theoretical teaching	Control systems with centralized information and control structure. Multivariable control systems. The generalization of the classical methods for the synthesis of a multivariable control systems. Robustness of multivariable systems. Linear quadratic and linear Gaussian quadratic controller. Robustness of control systems with linear quadratic regulator. Control systems with decentralized information and control structure. Control of large-scale dynamical systems with decentralized information and control structure. Robustness of large-scale dynamical systems with decentralized information and control structure. Generalization and application of the results of the robustness of decentralized systems. Modern concepts in the design of control systems of technological processes.			
Practical teaching (exercises, OFE, study and research				
Textbooks/references				
1	Graham C. Goodwin, Stefan F. Graebe, Mario E. Salgado, "Control System Design", Pearson, 2001.			
2	S. Skogestad, I. Postlethwaite, "Multivariable Feedback Control: Analysis and Design", John Wiley & Sons, 2001.			
3	Dj. Petkovski, "Modern methods of automatic control of large-scale systems: Theory and applications", Privredni pregled, Belgrade, 1983. (in Serbian)			
4				
5				
Number of classes of active education per week during semester/trimester/year				
Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	2	0		
Teaching methods	Lectures; Auditory exercises; Computer exercises; Consultations			
Grade (maximum number of points 100)				
Pre-exam duties	**Points**	**Final exam**	**Points**	
Activity during lectures		**Written exam**	30	
Exercises		**Oral exam**	30	
Colloquia				
Projects	40			

Specification for the book of courses

Study program	Control Systems		
Module	Automatic Control		
Type and level of studies	Master studies		
The name of the course	Predictive Control		
Lecturer (for lectures)	Antić S. Dragan, Mitić B. Darko		
Lecturer/associate (for exercises)	Spasić D. Miodrag		
Lecturer/associate (for OFE)			
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	
Course objectives	The aim of the course is to provide fundamental knowledge of theory and design of model predictive control (MPC) and regulator design.
Course outcomes	Knowledge of system modeling which is appropriate for MPC apllication. Skills to identify control problem and to design and implement corresponding MPC regulators.
Course outline	
Theoretical teaching	Introduction to model predictive control (MPC). Models and modeling. Linear dynamic models. Input-output models. Discrete models. Constraints. Linear quadratic regulator. Optimizing multistage function. Dynamic programming. Controllability. State estimation. Linear systems and normal distribution. Discrete-time MPC. State-space models with embedded integrator. Predictive control within one optimization window. Receding horizon control. Predictive control of MIMO systems. State estimation in predictive control. Discrete-time MPC with constraints. Discrete-time MPC using Laguerre functions (DMPC). Continuous-time MPC. Model structures for continuous-time MPC design. MPC using finite prediction horizon. Optimal control strategy. Continuous-time MPC with constraints. Formulating of constraints. Numerical solutions for the constrained control problem. Real-time implementation of continuous-time MPC. MPC systems in state space formulation.
Practical teaching (exercises, OFE, study and research work)	Discrete-time MPC. Introduction to model predictive control (MPC). Generation of optimal control by parameters tuning. Implementation of receding horizon. Observer design. Constrained control problems. Quadratic programming. Simulation of predictive control system with/without observer. Continuous-time system modeling using Laguerre functions. Continuous-time systems modeling using Kaitz functions. Constrained systems modeling. Basis for the design of continuous-time MPC system. Closed-loop simulation of MPC system. Nyquist plot of the predictive control system. Implementation of predictive control systems.
Textbooks/references	
1	Wang L., Model Predicitive Control Systems Design and Implementation Using MATLAB, Springer, 2009.
2	Rawlings B. R., Mayne D.Q., Model Predicitive Control: Theory and Design, Nob Hill Publishing, 2009
3	
4	
5	

Number of classes of active education per week during semester/trimester/year

Lectures	Exercises	OFE	Study and research work	Other classes
2	2	0		

Teaching methods	Lectures; Auditory exercises; Computing exercises

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points
Activity during lectures		Written exam	20
Exercises		Oral exam	20
Colloquia	60		
Projects			

Specification for the book of courses

Study program	Control Systems			
Module	Automatic Control			
Type and level of studies	Master studies			
The name of the course	Hydraulic and Pneumatic Control Systems			
Lecturer (for lectures)	Nikolić D. Vlastimir			
Lecturer/associate (for exercises)	Todorović Z. Darko			
Lecturer/associate (for OFE)				
Number of ECTS	5	**Course status (obligatory/elective)**	Elective	
Prerequisites				
Course objectives	Gaining knowledge in basics of hydraulics and pneumatics. Analysis and design of hydraulic and pneumatic control systems.			
Course outcomes	Theoretical and practical knowledge in basics of hydraulics and pneumatics, modelling of hydraulic and pneumatic systems, as well as analysis of hydraulic and pneumatic control systems.			
Course outline				
Theoretical teaching	Hydraulic drive. Hydraulic actuators, pumps and motors. Hydraulic control elements. Elements of the data transfer. Electro-hydraulic servo valves and electrohydraulic servomechanisms. Control concepts for hydraulic control systems. Methods for the analysis of electrohydraulic control systems. Nonlinearities in the hydraulic control system. Analysis of specific cases. Features of the air. Providing pressure, transmission and control. Pneumatic valves, compressors, pneumatic cylinders and motors, pneumatic drive. Pneumatic control techniques. Fluid logic. Fluid amplifiers.			
Practical teaching (exercises, OFE, study and research	Practical examples that follow and illustrate the lecture units.			
Textbooks/references				
1	H. Marrit, Hydraulic control systems, Prentice Hall International, 1989			
2	J. Watton, Fluid power systems – modeling, simulation, analog and microcomputer control, Prentice Hall International, Hertfordshire, 1989.			
3	R. B. Walters, Hydraulic and electro-hydraulic systems, Elsevier Applied Science, New York, 1991.			
4	Z. Ribar, Pneumoelectrical control systems (in Serbian), Faculty of Mechanical Engineering in Belgrade, 1997.			
5	R. Mirković, Hydraulics: Introduction with applications in control (in Serbian), second edition, Micro book, 2013.			
Number of classes of active education per week during semester/trimester/year				
Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	2	0		
Teaching methods	Lectures, Auditory Exercises, Computer Exercises; Consultations			
Grade (maximum number of points 100)				
Pre-exam duties	**Points**	**Final exam**	**Points**	
Activity during lectures	10	**Written exam**		
Exercises	10	**Oral exam**	30	
Colloquia	30			
Projects	20			

Specification for the book of courses

Study program	Control Systems			
Module	Automatic Control			
Type and level of studies	Master studies			
The name of the course	Electromedical Instrumentation			
Lecturer (for lectures)	Radenković N. Dragan			
Lecturer/associate (for exercises)	Dinčić R. Milan			
Lecturer/associate (for OFE)	Jocić V. Aleksandar, Đorđević-Kozarov R. Jelena			
Number of ECTS	5	**Course status (obligatory/elective)**	Elective	
Prerequisites				
Course objectives	Mastering basic knowledge necessary for understanding the functioning of electromedical instruments.			
Course outcomes	Theoretical and practical knowledge about working principles and structure of appropriate electromedical devices.			
Course outline				
Theoretical teaching	Cell as a source of bioelectric potential. Electrodes for measuring biopotentials. Instruments for registering EMG, ECG and EEG signals. Devices for electrostimulation and electrotherapy. Pacemakers and defibrillators. Instruments for the formation of a medical image based on electromagnetic radiation and on the basis of nuclear magnetic resonance. Other electromedical instruments.			
Practical teaching (exercises, OFE, study and research	Practice, laboratory exercises, realization of seminar and project tasks for the purpose of studying and practical applications of electromedical instrumentation.			
Textbooks/references				
1	D. Radenković, A. Micić, “Electromedical instrumentation”, Faculty of Electronic Engineering Niš, 2007 (in Serbian).			
2	D.Jennings, A.Flint, B.C.H.Turton and L.D.M.Nokes, “Introduction to Medical Electronics Application”, EDWARD ARNOLD, London 1995.			
3	David Prutchi, Micahel Norris, “Design and Development of Medical Electronic Instrumentation”, JOHN WILEY & SONS, New Jersey 2005.			
4				
5				
Number of classes of active education per week during semester/trimester/year				
Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	1	1		
Teaching methods	Lectures, practice, laboratory exercises, consultations			
Grade (maximum number of points 100)				
Pre-exam duties	**Points**	**Final exam**	**Points**	
Activity during lectures	10	**Written exam**	25	
Exercises	10	**Oral exam**	25	
Colloquia	30			
Projects				

Specification for the book of courses

Study program	Control Systems		
Module	Automatic Control		
Type and level of studies	Master studies		
The name of the course	Fourier Analysis and Applications		
Lecturer (for lectures)	Rančić Z. Lidija, Matejić M. Marjan		
Lecturer/associate (for exercises)	Jovančić S. Vladan		
Lecturer/associate (for OFE)			
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	
Course objectives	Mastering the general principles and techniques of applying Fourier analysis.Training students to apply acquired knowledge to solve engineering problems, especially problems in signal theory, information-communication techniques and applied numerical analysis.
Course outcomes	Developed ability to identify problems in the field of interest and their solving by the methods of Fourier analysis. The ability to apply the acquired knowledge and skills in practice.
Course outline	
Theoretical teaching	Fourier series. Analysis of convergence. Fourier integral, Fourier transform, inverse Fourier transform.Characteristics of the Fourier transform. Distributions.Convolution and correlation. Discrete Fourier transform.Fast Fourier transform and Cooley-Tukey algorithm. Cosinous Fourier transform.Multidimensional Fourier transform. Analysis of linear systems.Window functions. Applications in solving practical engineering and scientific problems.
Practical teaching (exercises, OFE, study and research	Solving mathematical models of simpler problems in practice.
Textbooks/references	
1	Dušan Milošević, Lidija Rančić, Miodrag Petković, Mathematics IV, Faculty of Electronic Engineering, University of Niš, 2015 (Serbian)
2	Brad Osgood, Lecture Notes for EE 261 The Fourier Transform and its Applications, Electrical Engineering Department Stanford University
3	e-presentation - https://moodle.elfak.ni.ac.rs/
4	
5	

Number of classes of active education per week during semester/trimester/year				
Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	2	0		
Teaching methods	Lectures, auditory exercises, consultations			

Grade (maximum number of points 100)			
Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures	10	**Written exam**	20
Exercises	10	**Oral exam**	20
Colloquia	40		
Projects			

Specification for the book of courses

Study program			Control Systems		
Module			Automatic Control		
Type and level of studies			Master studies		
The name of the course			Modern Control of Industrial Processes		
Lecturer (for lectures)			Milojković T. Marko		
Lecturer/associate (for exercises)			Milovanović B. Miroslav		
Lecturer/associate (for OFE)			Milovanović B. Miroslav		
Number of ECTS		5	**Course status (obligatory/elective)**		Elective
Prerequisites					
Course objectives	Introduction to the concepts of the Industry 4.0. Mastering advanced modeling and simulation techniques in production. Introduction to the ideas of Industrial Internet of Things (IIoT), Big Data and Cloud computing. Mastering the methodologies for the digital transformation of industrial applications. The application of the virtual reality in production. Introduction to the process of additive production and 3D printing. Application of the blockchain technologies in production processes.				
Course outcomes	Theoretical and practical knowledge on the elements of Industry 4.0, areas of IIoT, design of automatic control system with the possibility of internet and distributed computer systems control, as well as the digitization of conventional control logic. Mastering the techniques of additive manufacturing and the application of virtual reality in manufacturing. Practical implementation of blockchain applications in improving production cycles.				
Course outline					
Theoretical teaching	Industry 4.0. Cyber-physical environment for smart production. Virtual reality in the industry. Examples of applications of expanded reality in production. Additive production. 3D printing - preparation and realization of 3D models. Industrial Internet of Things (IIoT). Examples of IIoT applications. Network protocols and standards for the implementation of the IIoT system. Architecture of the IIoT system. Blockchain technology. Using blockchain technologies in the industry. Development of blockchain applications.				
Practical teaching (exercises, OFE, study and research	Laboratory work with equipment for virtual reality. 3D modeling, preparation for printing and printing on a 3D printer. Practical development of the IIoT system using the development boards Arduino and Raspberry Pi. Development of blockchain applications in the Python programming language.				
Textbooks/references					
1	S. Raschka, "Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and Tensor Flow, 2nd Edition", Packt Publishing, 2017.				
2	C. Dow, "Internet of Things Programming Projects : Build modern IoT solutions with the Raspberry Pi 3 and Python", Packt Publishing, 2018.				
3	P. Desai, "Python Programming for Arduino", Packt Publishing, 2015				
4	S. Monk, "Programming The Raspberry Pi", McGraw-Hill Education TAB, 2015.				
5	A. Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", O'Reilly Media, 2017				
Number of classes of active education per week during semester/trimester/year					
Lectures	**Exercises**	**OFE**	**Study and research work**		**Other classes**
2	1	1			
Teaching methods	Lectures, Practical classes, Laboratory classes, Consultations				
Grade (maximum number of points 100)					
Pre-exam duties		**Points**	**Final exam**		**Points**
Activity during lectures			**Written exam**		30
Exercises		20	**Oral exam**		30
Colloquia					
Projects		20			

Specification for the book of courses

Study program	Control Systems		
Module	Computer Control Systems and Measurement Techniques		
Type and level of studies	Master studies		
The name of the course	Computer Systems for Measurement and Control		
Lecturer (for lectures)	Živanović B. Dragan, Dinčić R. Milan		
Lecturer/associate (for exercises)	Miljković S. Goran		
Lecturer/associate (for OFE)	Miljković S. Goran		
Number of ECTS 5	**Course status (obligatory/elective)**	Elective	

Prerequisites	
Course objectives	The aim of the subject is to allow students to introduce with hardware and software of systems for measurement and control, to learn all techniques of connection of single components into complex system, considering the influence of the applied techniques on the measurement accuracy.
Course outcomes	Student will be abble to decide whether to use virtual instruments, centralized or distributed measurement systems to solve project task, which components should be used and to recognize potential problems which could occur in practice.

Course outline

Theoretical teaching	Measurement of non-electrical quantities. Connection of sensors, measurement transducers and actuators with computer. Hardware structure of computer-based measurement systems. Standard interface systems for measurement techniques. SCADA systems. Distributed measurement systems. Components of distributed systems. Inteligent measurement transducers. Hardware and software techniques of compensation of measurement results. Inteligent sensors in cars. Electrical isolation in measurement systems. Protocols of industrial networks. Protocols for inteligent sensors in cars. Wireless sensor networks. Virtual instrumentation and virtual laboratories. Examples of practical implementation of computer-based measurement systems. Real-time work. Software design. Internet connection. Calibration of computer-based measurement devices and systems. Automatic test systems. Measurement systems for car testing.
Practical teaching (exercises, OFE, study and research	Preparation of project tasks and seminar papers in the field of theoretical lectures.

Textbooks/references

1	D. Denic, I. Randjelovic, D. Zivanovic, „Computer-based measurement systems in industry“,(in Serbian) Faculty of electronic engineering Nis and WUS Austria, script, 2005.
2	V.Drndarevic, "Acquisition of measuring data using Computer", (in Serbian) institute of Nuclear Science, Vinca, 1999.
3	Burns, M.,Roberts,G.W.,"Mixed-Signal IC Test and Measurement",Oxford Univ. Press,New York, 2001.
4	Lang, T.T., "Computerized Instrumentation", John Wiley & Sons, 1990.
5	

Number of classes of active education per week during semester/trimester/year

Lectures	Exercises	OFE	Study and research work	Other classes
2	1	1		

Teaching methods	Lectures with the use of modern presentation techniques and devices, discussion of , student's solutions of the given tasks, consultations, computational exercises.

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points
Activity during lectures	5	Written exam	20
Exercises	20	Oral exam	25
Colloquia	30		
Projects			

Specification for the book of courses

Study program	Control Systems		
Module	Computer Control Systems and Measurement Techniques		
Type and level of studies	Master studies		
The name of the course	Design of Microcomputer Measurement Instruments		
Lecturer (for lectures)	Živanović B. Dragan		
Lecturer/associate (for exercises)	Đorđević-Kozarov R. Jelena, Stojković S. Ivana		
Lecturer/associate (for OFE)	Đorđević-Kozarov R. Jelena, Stojković S. Ivana		
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	
Course objectives	Microcomputer as a part of a measurement instrument. Introduction with hardware-software structure of particular instruments. Understanding of working principles of analog and digital electronic circuits in instruments. Understanding influences of different ways of realization of some measurement functions on measurement accuracy.
Course outcomes	The ability of students to understand working principles of instruments based on microcontrollers and to design them according to the required project task and metrological characteristics.
Course outline	
Theoretical teaching	Architecture of microprocessors, microcomputers and DSP. Input-output devices. Analog circuits of measurement instruments. Analog to digital conversion in measurement instruments. Measurement of time and frequency in microcomputer devices. Designing of hardware of microcomputer devices. Examples of practical implementations of microcomputer instruments. Real time work. Software designing. Virtual instruments. Testing in the phase of development of microcomputer devices.
Practical teaching (exercises, OFE, study and research	Preparation of project tasks and seminar papers in the field of theoretical lectures.
Textbooks/references	
1	J. Valvano, "Embedded Microcomputer Systems - Real Time Interfacing", Cengage Learning, 2011.
2	M.A.Mazidi, J.G.Mazidi,R.D.McKinlay," The 8051 Microcontroller and Embedded systems", Pearson Education, 2006, ISBN-0-13-197089-5.
3	Ball, S.R., "Embedded Microporcessor System: real word design", Butterwort-Heinmann, Melburne New Delhi, 2000.
4	V.Drndarevic, "Acquisition of measuring data using Computer", (in Serbian) institute of Nuclear Science, Vinca, 1999.
5	Barney, G.C., “Intelligent Instrumentation”, Prentice Hall, New York, 1998.

Number of classes of active education per week during semester/trimester/year

Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	1	1		

Teaching methods	Lectures with the use of modern presentation techniques and devices, discussion of , student's solutions of the given tasks, consultations, computational exercises.

Grade (maximum number of points 100)

Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures	10	**Written exam**	20
Exercises	20	**Oral exam**	20
Colloquia	0		
Projects	30		

Specification for the book of courses

Study program	Control Systems
Module	Computer Control Systems and Measurement Techniques
Type and level of studies	Master studies
The name of the course	Modelling and Simulation in Automotive Industry
Lecturer (for lectures)	Antić S. Dragan, Perić Lj. Staniša
Lecturer/associate (for exercises)	Danković B. Nikola
Lecturer/associate (for OFE)	

Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	
Course objectives	The course aims to take the student's existing knowledge of basic mechanics and modelling and simulation of dynamical systems and apply them to road vehicles, in particular, vehicle subsystems, vehicle ride and handling behaviour. The key to the course material is the understanding of various dynamical equations of motion governing vehicle behaviour as well as computer simulation.
Course outcomes	At the end of the course students will be able to: model the dynamics of vehicle subsystems and provide fundamental recommendation to design and improve the function of the subsystems based on computer simulation; develop a model for vehicle lateral and longitudinal dynamics, as well as vehicle ride behaviour; apply fundamental simulation techniques to analyze vehicle dynamic behaviuor including validation.
Course outline	
Theoretical teaching	Introduction to the basic mathematical and mechanics concepts relevant for analyzing vehicle dynamics. Modelling and simulation of vehicle subsystems: tire; steering; suspension; gearbox; engine. Modelling and simulation of vehicle ride: vehicle/driver motions; vehicle vibration (frequency, dumping); suspension behavior of quarter car model, design and practical issues (springs, dumpers); road surface inputs and human response. Modelling and simulation of vehicle handling: understeer and oversteer; modelling and simulation of tires, their force and moment behavior. Modelling and simulation of ABS, ESP. Graphical methods of vehicle modeling. Case studies of modelling and simulation of vehicle ride and handling.
Practical teaching (exercises, OFE, study and research	Introduction to the Matlab software environment related to automotive industry. Modelling and simulation of tire subsystem. Modelling and simulation of steering subsystem. Modelling and simulation of suspension subsystem. Modelling and simulation of gearbox subsystem. Modelling and simulation of engine subsystem. Modelling and simulation of vehicle handling. Quarter car model. Modeling and simulation of ABS. Modeling and simulation of ESP.
Textbooks/references	
1	Dragan Antić, Bratislav Danković, “Modelling and simulation of dynamical systems” (in Serbian), Faculty of Electronic Engineering in Nis, 2001.
2	Dragan Antić, “Handbook on modelling and simulation of dynamical systems” (in Serbian), Faculty of Electronic Engineering, 2006.
3	Uwe Kiencke, Lars Nielsen, "Automotive Control Systems: For Engine, Driveline, and Vehicle", Springer Verlag, 2005.
4	Reza N. Jazar, "Vehicle Dynamics: Theory and Application", Springer Verlag, 2008.
5	A. Galip Ulsoy, Huei Peng, Melih Çakmakci, "Automotive Control Systems", Cambridge University Press, 2012.

Number of classes of active education per week during semester/trimester/year

Lectures	Exercises	OFE	Study and research work	Other classes
2	2	0		

Teaching methods	Lectures, Auditory Exercises, Computer Exercises; Consultations

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points
Activity during lectures	10	Written exam	20
Exercises	20	Oral exam	20
Colloquia	30		
Projects			

Specification for the book of courses

Study program	Control Systems		
Module	Computer Control Systems and Measurement Techniques		
Type and level of studies	Master studies		
The name of the course	Wireless Sensors and Sensor Networks		
Lecturer (for lectures)	Dinčić R. Milan, Denić B. Dragan, Radenković N. Dragan		
Lecturer/associate (for exercises)	Pešić T. Miroljub, Jocić V. Aleksandar		
Lecturer/associate (for OFE)	Pešić T. Miroljub, Jocić V. Aleksandar		
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	
Course objectives	Basics of working principles of the sensors. Studying techniques for acquisition and data processing using wireless sensors and sensor networks. Getting acquainted with the applications of wireless sensors and sensor networks. Getting acquainted with hardware-software platforms for the realization of wireless sensor networks.
Course outcomes	Students will acquire the necessary theoretical knowledge about different types of sensors as well as ways of data acquisition using wireless sensors and sensor networks. Students will obtain an insight into the numerous applications of wireless sensors and sensor networks, thus gaining the ability to solve specific problems in practice. Students will gain the ability to realize and use wireless sensor networks on their own.
Course outline	
Theoretical teaching	Working principles of basic sensor types in wireless sensor networks. Intelligent wireless sensors. Definition, principle of operation and architecture of wireless sensor networks. Data acquisition using wireless sensors and sensor networks. Data processing and compression in wireless sensors and sensor networks. Protocols in wireless sensor networks. Application of wireless sensors and sensor networks in industry, military, construction, medicine, seismology, biology, agrosystems, etc. Hardware-software platform for realization of wireless sensor networks. Connecting wireless sensor networks to IoT systems.
Practical teaching (exercises, OFE, study and research	Practice, laboratory exercises, realization of projects and seminar tasks
Textbooks/references	
1	H. Ammari ed., "The Art of Wireless Sensor Networks", Springer, 2014.
2	R. Budampati, S. Kolavennu, "Industrial Wireless Sensor Networks", Elsevier, 2016.
3	Robert Faludi, "Building Wireless Sensor Networks", O'Reilly Media, 2010.
4	Mohammad Matin, "Wireless Sensor Networks-Technology and Applications", In Tech 2012.
5	A. Forster, "Introduction to Wireless Sensor Networks", Wiley, 2016.

Number of classes of active education per week during semester/trimester/year

Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	1	1		

Teaching methods	Lectures; Practice; Laboratory exercises; Consultations; Realization of project tasks

Grade (maximum number of points 100)

Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures	5	**Written exam**	25
Exercises	20	**Oral exam**	25
Colloquia	25		
Projects			

Specification for the book of courses

Study program	Control Systems
Module	Computer Control Systems and Measurement Techniques
Type and level of studies	Master studies
The name of the course	Telemetry
Lecturer (for lectures)	Denić B. Dragan, Jovanović R. Jelena
Lecturer/associate (for exercises)	Miljković S. Goran, Jovanović R. Jelena
Lecturer/associate (for OFE)	Miljković S. Goran, Jovanović R. Jelena

Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	
Course objectives	The course has the goal to introduce students with basic transmission techniques of measurement signals and configuration of modern measurement systems used for remote measurement.
Course outcomes	Capability to define basic problems related to transmission of measurement signals and realisation of modern measurement systems used for remote measurements. Designing of simple telemetry system examples and estimation of standards fulfillment. Capability to work with modern measurement systems used for remote measurements.
Course outline	
Theoretical teaching	Basic terms and definitions; pneumatic telemetry systems; analog telemetry systems, frequency and pulse-width modulation; transmitters; two-wire transmitters, serial and parallel power sources; analysis of concrete two-wire transmitter examples, analogue and digital telemetry systems; delta modulation; digital telemetry systems; FSK (frequency-shift keying) modulation; pulse code modulation (PCM); digital transmitters; digital two-wire transmitters; universal asynchronous receiver-transmitter; computer based telemetry systems; standard interface systems; modems; automotive telemetry systems; fiber-optic telemetry systems; industrial telemetry systems, biotelemetry, virtual instrumentation and Internet in telemetry systems; connection of distant measurement systems, distributed virtual laboratories; telemetry system testing; telemetry standards; the basic principles of Internet of Things technology and its applications in telemetry systems.
Practical teaching (exercises, OFE, study and research	Demonstration of operational principles of measurement systems that are based on the Arduino platform, through various measurement examples of environmental parameters.
Textbooks/references	
1	D. Denić, G. Miljković, Telemetry - script (in Serbian), on the website of the Faculty of Electronic Engineering, 2007.
2	D. Denić, I. Ranđelović, D. Živanović, Computer Measurement and Information Systems in Industry - script (in Serbian), Faculty of Electronic Engineering in Niš, and WUS Austria, script, 2005.
3	J.Webster, “The measurement, instrumentation, and sensors handbook”, CRC Press, 1999.
4	S. Horan, “Introduction to PCM telemetering systems”, CRC Press, 2002.
5	W. Nawrocki, „Measurement systems and sensors“, Artech House, 2005.

Number of classes of active education per week during semester/trimester/year

Lectures	Exercises	OFE	Study and research work	Other classes
2	1	1		

Teaching methods	Theoretical and practical teaching, seminar papers. Practical teaching is of demonstrational type.

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points
Activity during lectures	5	**Written exam**	20
Exercises	10	**Oral exam**	10
Colloquia	40		
Projects	15		

Specification for the book of courses

Study program	Control Systems		
Module	Computer Control Systems and Measurement Techniques		
Type and level of studies	Master studies		
The name of the course	Sensors and Transducers in Vehicles		
Lecturer (for lectures)	Dinčić R. Milan, Denić B. Dragan, Radenković N. Dragan		
Lecturer/associate (for exercises)	Pešić T. Miroljub, Miljković S. Goran		
Lecturer/associate (for OFE)	Pešić T. Miroljub, Miljković S. Goran		
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	
Course objectives	Acquiring knowledge about production technologies, implementation, networking and applications of sensor systems in vehicles.
Course outcomes	Students will gain theoretical and practical knowledge of types, principles of operation, implementation and application of sensors in cars and vehicles.
Course outline	
Theoretical teaching	Types of sensors in vehicles, development trends, manufacturing technologies, MEMS sensors, GMP sensors. Functional, safety and control sensors in cars. Position sensors, force and moment sensors, pressure sensors, flow meters, temperature sensors, gas sensors and concentration sensors. Actuators in cars. Processing of sensor signals. Data exchange between automotive electronic systems. Connecting the sensors and actuators to the central computer system in the vehicle. The main requirements and directions of the development of sensors and actuators in the automotive industry. Sensors in autonomous and electrical vehicles.
Practical teaching (exercises, OFE, study and research	Practice, laboratory exercises, realization of seminar and project tasks, practical implementation of sensor systems.
Textbooks/references	
1	D. Denić, M. Dinčić, D. Radenković, "Sensors in vehicles", the script, University of Niš (in Serbian), 2014.
2	"Bosch Automotive Electrics and Automotive Electronics", 5th edition, Springer, 2014.
3	S. Bhattacharya, A. K. Agarwal, O. Prakash, S. Singh, ed., "Sensors for Automotive and Aerospace Applications", Springer, 2019.
4	J. Marek, H.-P. Trah, Y. Suzuki, I. Yokomori, "Sensors applications, volume 4 - Sensors for Automotive Applications", John Wiley and Sons, 2003.
5	W. Ribbens, "Understanding Automotive Electronics", 8th edition, Elsevier, 2017.

Number of classes of active education per week during semester/trimester/year

Lectures	Exercises	OFE	Study and research work	Other classes
2	1	1		

Teaching methods	Lectures, practice, laboratory exercises, realization of project and tasks, consultations.

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points
Activity during lectures	5	**Written exam**	25
Exercises	15	**Oral exam**	25
Colloquia	30		
Projects			

Specification for the book of courses

Study program	Control Systems		
Module	Computer Control Systems and Measurement Techniques		
Type and level of studies	Master studies		
The name of the course	Sensors and Transducers in Control and Robotics		
Lecturer (for lectures)	Dinčić R. Milan, Radenković N. Dragan		
Lecturer/associate (for exercises)	Pešić T. Miroljub, Jocić V. Aleksandar		
Lecturer/associate (for OFE)	Pešić T. Miroljub, Jocić V. Aleksandar		
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	
Course objectives	Introduction of students with types and significance of sensors, as well as with the techniques for realization of sensor systems in control and robotics.
Course outcomes	Students will obtain theoretical and practical knowledge about robotic sensors (about types, principles of work, technology of production and significance of sensors), as well as about practical realization of sensor systems in robotics.
Course outline	
Theoretical teaching	Importance and types of sensors in control and robotics. Trends in the development of sensors in robotics. Sensor technologies. Proximity sensors. Sensors of force and moment. Tactile sensors. Sensors of robotic vision. Sensors of ultrasonic vision. Navigation sensors and gyroscopes. Multisensor robotic systems. Integration of the sensors into the control system.
Practical teaching (exercises, OFE, study and research	Practice, laboratory exercises, realization of seminar and project tasks for the purpose of studying and practical implementation of sensor systems in robotics.
Textbooks/references	
1	M. Popović, "Sensors in robotics", 2006 (in Serbian).
2	D. Stanković, "Phisical-technical measurements, sensors", University of Belgrade, 1997 (in Serbian).
3	S. Ruocco, "Robot sensors and transducers", Open University Press, 1987.
4	H.R.Everett, "Sensors for Mobile Robots-Theory and Application", A K Peters, Ltd., 1995.
5	J. G. Webster, "Measurement, Instrumentation and Sensors Handbook", CRC Press, 2014.

Number of classes of active education per week during semester/trimester/year

Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	1	1		

Teaching methods	Lectures, practice, laboratory exercises, realization of seminar tasks and projects, consultations.

Grade (maximum number of points 100)

Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures	5	**Written exam**	25
Exercises	20	**Oral exam**	25
Colloquia	25		
Projects			

Specification for the book of courses

Study program	Control Systems		
Module	Computer Control Systems and Measurement Techniques		
Type and level of studies	Master studies		
The name of the course	Modern Sensor Technologies and Systems		
Lecturer (for lectures)	Dinčić R. Milan, Radenković N. Dragan		
Lecturer/associate (for exercises)	Miljković S. Goran, Jocić V. Aleksandar		
Lecturer/associate (for OFE)	Miljković S. Goran, Jocić V. Aleksandar		
Number of ECTS	5	**Course status (obligatory/elective)**	Elective
Prerequisites			
Course objectives	Introduction of students with modern sensor technologies (MEMS sensors, optical fiber sensors), modern sensor systems (IoT (Internet of Things), systems for measurement and analysis of vibration signals, wireless sensor systems), modern technologies for wireless transfer of measurement data (via mobile networks, using 5G wireless systems), modern platforms for realization of sensor systems (Arduino, Raspberry Pi, LabVIEW, FPGA).		
Course outcomes	Students will gain theoretical and practical knowledge of modern sensor technologies and systems. Also, students will master knowledge about hardware-software realization of sensor systems.		
Course outline			
Theoretical teaching	Characteristics, technology of production, principles of operation and applications of MEMS sensors and optical fiber sensors. Characteristics, applications and hardware-software technologies for the implementation of the IoT system. Characteristics and communication technologies for realization of wireless sensor systems. Measurement of the vibration signal. Application of vibration signals in predictive maintenance in industry. Hardware-software platforms for the implementation of sensor systems (Arduino, Raspberry Pi, LabVIEW, FPGA).		
Practical teaching (exercises, OFE, study and research	Practice, laboratory exercises, realization of project and seminar tasks, in order to enable students to master practical knowledge in the design and implementation of sensor systems.		

Textbooks/references

1	Krzysztof Iniewski (editor), "Optical, acoustic, magnetic, and mechanical sensor technologies", CRC Press, 2012.
2	Castañer, Luis, "Understanding MEMS : principles and applications", Wiley, 2015.
3	Hamid Sharif, Hamid Sharif, Yousef S. Kavian, "Technological breakthroughs in modern wireless sensor applications", 2015.
4	Dejan Drajić, "Introduction to IoT", 2018 (in Serbian).
5	Dogan Ibrahim, "Raspberry Pi 3, from basic to advanced projects", 2014.

Number of classes of active education per week during semester/trimester/year

Lectures	Exercises	OFE	Study and research work	Other classes
2	1	1		

Teaching methods	Lectures using modern presentation tools, discussion of student solutions, consultations, practice, laboratory exercises.

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points
Activity during lectures	5	Written exam	25
Exercises	20	Oral exam	25
Colloquia	25		
Projects			

Specification for the book of courses

Study program	Control Systems		
Module	Computer Control Systems and Measurement Techniques		
Type and level of studies	Master studies		
The name of the course	Virtual Measurement Instrumentation		
Lecturer (for lectures)	Živanović B. Dragan, Simić M. Milan		
Lecturer/associate (for exercises)	Simić M. Milan, Miljković S. Goran		
Lecturer/associate (for OFE)	Simić M. Milan, Miljković S. Goran		
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	
Course objectives	Aim of the subject is introduction with concept, hardware and techniques for programming of virtual measuring instruments, as with specific examples of measuring systems.
Course outcomes	Capability of student to select, on the basis of specific project tasks, components of measuring system and to realize program in „LabVIEW“ graphical programming language.
Course outline	
Theoretical teaching	Hardware of virtual instruments. Types of acquisition modules, characteristics. Programming language LabVIEW, concept and basic techniques. Front panel, block diagram, functions palettes. Data stream and parallel execution of code segments. Signal analysis. Reduction of measurement errors in virtual instruments. Linearisation, compensation of influential quantities, calibration. Advanced data presentation. Serial communication with separated instruments. Connection of sensors and actuators. Examples for specific implementations of measuring systems.
Practical teaching (exercises, OFE, study and research	Laboratory exercises: Learning of LabVIEW programming language basics. Solving of complicated programming tasks. Examples of specific virtual instruments for measurement of temperature, impedance parameters, AD converter characteristics. Realization of project tasks and seminar papers from area of theoretical teaching.
Textbooks/references	
1	G.C. Barney, “Intelligent Instrumentation”, Prentice Hall, New York, 1998.
2	V.Drndarevic, "Acquisition of measuring data using Computer", (in Serbian) institute of Nuclear Science, Vinca, 1999.
3	National Instruments, "Measurement and Automation Catalog", National Instruments Catalog.
4	S. Tumanski „ Pricniples of Electrical Measurement“, Taylor&Francis
5	

Number of classes of active education per week during semester/trimester/year

Lectures	Exercises	OFE	Study and research work	Other classes
2	1	1		

Teaching methods	Lectures with using of modern resources for presentation, discussion of students solutions for defined tasks, consultations. Practical teaching will be performed in laboratory equipped with computers.

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points
Activity during lectures	10	Written exam	20
Exercises	20	Oral exam	20
Colloquia	15		
Projects	15		

Specification for the book of courses

Study program	Control Systems		
Module	Computer Control Systems and Measurement Techniques		
Type and level of studies	Master studies		
The name of the course	Control Systems in Vehicles		
Lecturer (for lectures)	Mitić B. Darko, Perić Lj. Staniša		
Lecturer/associate (for exercises)	Sibinović D. Vladimir		
Lecturer/associate (for OFE)			
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	
Course objectives	The aim of the course is to familiarise students with the control issues of the automotive subsystems that influence the general behaviour of the whole vehicle. The course will cover control system design and numerical simulation of automotive subsystems such as brake system, ride & handling systems (suspension, steering, ESP), and power-train (transmission, clutch, launch control, electronic differential). The course will start with the most widely used control structure in automotive applications and end with the advanced control topics that include system constraints in the design and the driver system closed loop control. This course will also address the design, control and implementation of these systems using the platform of MATLAB and SIMULINK.
Course outcomes	Upon completion of this course students will be able to: • formulate and solve control engineering tasks related to the most representative automotive systems using the Control Theory methodology. • model and simulate complex automotive systems in computer interactive environment, using modern numerical analysis and simulation tools.
Course outline	
Theoretical teaching	Introduction to vehicle control and basis of systems control engineering. Vehicle as a system, controlled by tyre forces and internal suspension loads, with interfaces to the driver and the traffic environment. Control of lateral dynamics. Control of longitudinal dynamics. Control of vertical dynamics. Applications of dynamics control systems. Assistance systems in commercial vehicles. Development of control systems for automotive applications. Power steering (EPS, EHPS). Integrated vehicle (body) control. Suspension control. Introduction to traction and brake control (ESP, ESC, DSC, ABS). Development of mathematical models in continuous- and discrete-time domain. Advanced control algorithms (fuzzy, neural network, sliding mode) designed and applied in automotive applications.
Practical teaching (exercises, OFE, study and research	Coordinates and Notation for Vehicle Dynamics. Longitudinal Vehicle Motion. Lateral Vehicle Motion. Vertical Vehicle Motion. Linear Vehicle Model. Nonlinear Vehicle Model. Design of model for ABS, ESP. Design of advanced control methods for automotive control systems. Simulation in Matlab and Simulink packages. Real-time experiments.
Textbooks/references	
1	Uwe Kiencke, Lars Nielsen, "Automotive Control Systems: For Engine, Driveline, and Vehicle", Springer Verlag, 2005.
2	Reza N. Jazar, "Vehicle Dynamics: Theory and Application", Springer Verlag, 2008.
3	A. Galip Ulsoy, Huei Peng, Melih Çakmakci, "Automotive Control Systems", Cambridge University Press, 2012.
4	
5	

Number of classes of active education per week during semester/trimester/year

Lectures	Exercises	OFE	Study and research work	Other classes
2	2	0		

Teaching methods	Lectures; Computer Exercises; Consultations

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points
Activity during lectures	10	Written exam	20
Exercises	20	Oral exam	30
Colloquia			
Projects	20		

Specification for the book of courses

Study program	Control Systems		
Module	Computer Control Systems and Measurement Techniques		
Type and level of studies	Master studies		
The name of the course	Mobile Communication Systems		
Lecturer (for lectures)	Marković V. Vera, Marinković D. Zlatica		
Lecturer/associate (for exercises)	Dimitrijević Ž. Tijana		
Lecturer/associate (for OFE)	Dimitrijević Ž. Tijana		
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	
Course objectives	Mastering the knowledge and skills in mobile communication systems. Introduction to the basic principles and techniques of mobile communications, as well as the specifics of current and future mobile systems and services that they offer.
Course outcomes	Ability to understand the basic principles of mobile communication. Knowledge of the mobile communication evolution from the first to the fifth generation. Knowledge of the architecture of up-to-date mobile systems and the principles of functioning of system components. Knowledge of 5G systems and their role in IoT.
Course outline	
Theoretical teaching	Evolution of the standards of mobile communication systems. Principles of mobile communications. Cellular approach. User equipment. GSM, GPRS and UMTS systems. HSPA and HSPA + systems. Architecture, functioning, characteristics and services of the LTE and LTE Advanced system. Basics of 5G systems. The role of 5G in IoT. Trends in the mobile communications market in Serbia and in the world.
Practical teaching (exercises, OFE, study and research	Solving practical problems in the field of mobile communication systems. Introduction to practical methods for testing the quality of services of mobile networks. Visits to companies.
Textbooks/references	
1	Teacher's script "Mobile Communication Systems" in e-form (in Serbian)
2	Gospić N., I. Tomić, D. Popović, D.Bogojević „Razvoj mobilnih komunikacija od GSM do LTE“, Saobraćajni fakultet,Beograd 2010, ISBN 978-86-7395-268-0 Udžbenik
3	D.P.Agrawal, Q.A.Zeng, Introduction to Wireless and Mobile Systems, Thomson, 2006
4	J. Rodriguez, “Fundamentals of 5G Mobile Networks”, Wiley, ISBN: 978-1-118-86752, 2015
5	J. Schiller, Mobile Communications, Addison-Wesley, 2000.

Number of classes of active education per week during semester/trimester/year

Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	2	1		

Teaching methods	Lectures, practical exercises, professional visits

Grade (maximum number of points 100)

Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures	5	**Written exam**	20
Exercises	5	**Oral exam**	20
Colloquia	50		
Projects			

Specification for the book of courses

Study program	Control Systems		
Module	Common		
Type and level of studies	Master studies		
The name of the course	Computer Control Systems		
Lecturer (for lectures)	Jovanović D. Zoran		
Lecturer/associate (for exercises)	Spasić D. Miodrag		
Lecturer/associate (for OFE)			
Number of ECTS	5	**Course status (obligatory/elective)**	Obligatory

Prerequisites	
Course objectives	Acquiring knowledge about computer control systems applied in centralized and distributed systems.
Course outcomes	Practical knowledge of the application of computers in the process industry and in the management of systems of decentralized and distributed structure (electrodistubutive, municipal, energy systems). Different levels and equipment in the process industry, from the production process to the business information system (PIS).
Course outline	
Theoretical teaching	Problems of managing complex technological processes. Centralized management. Distributed management. Hierarchical management. Select real-time PCs. Input output devices. Real-time system software support. Merging computers with technological processes. Application of microcomputers in the design and implementation of control systems. Application of the PLC system in process management. Application of computers in the process industry, in the management of machine tools and in the management of utility systems.
Practical teaching (exercises, OFE, study and research	Designing projects and realization of control algorithms and programs on various development platforms of programmable logic controllers. The acquired knowledge is verified on laboratory models made in the framework of student projects. Self-created application software is first checked within the development environment, and then on the models until complete program correction is performed.
Textbooks/references	
1	G. Olsson, G. Piani, “Computer Systems for Automation and Control”, Prentice Hall, 1992.
2	G. Kalani, “Industrial Process Control”, Elsevier Science, 2002.
3	M. Tooley, “PC-based Instrumentation and Control”, Newnes, 2001.
4	
5	

Number of classes of active education per week during semester/trimester/year

Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	2	0		

Teaching methods	Предавања; Аудиторне вежбе; Рачунарске вежбе; Консултације; Самосталан рад студената на изради домаћих задатака, и пројеката.

Grade (maximum number of points 100)

Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures	10	**Written exam**	
Exercises		**Oral exam**	40
Colloquia			
Projects	50		

Specification for the book of courses

Study program	Control Systems		
Module	Common		
Type and level of studies	Master studies		
The name of the course	Intelligent Systems		
Lecturer (for lectures)	Milojković T. Marko		
Lecturer/associate (for exercises)	Milovanović B. Miroslav		
Lecturer/associate (for OFE)	Milovanović B. Miroslav, Spasić D. Miodrag, Sibinović D. Vladimir		
Number of ECTS	5	**Course status (obligatory/elective)**	Obligatory

Prerequisites	
Course objectives	Introducing students with the principles of intelligent systems and applications of advanced machine learning techniques in the synthesis, analysis and optimization of industrial processes.
Course outcomes	Mastering the Python programming language. Gaining knowledge in the field of design and development of intelligent systems. Ability to apply various techniques of machine learning for the needs of analyzing and predicting the dynamics of industrial processes.
Course outline	
Theoretical teaching	Introduction to intelligent agents and intelligent systems. Basics of Industry 4.0. Working with large databases. Advanced machine learning techniques (decision tree, random forest, k nearest neighbors, naive bayes, linear and logistic regression, support vector machine). Application of advanced techniques of machine learning in the analysis, synthesis and optimization of industrial processes. Calculations in the cloud. Introduction to the current problems and possible solutions for the practical implementation and application of intelligent systems.
Practical teaching (exercises, OFE, study and research	Python programming language and the programming environment of Pycharm. Application of advanced techniques of machine learning in the analysis, synthesis and optimization of industrial processes. Designing intelligent systems and their application in practice on real analytical problems.
Textbooks/references	
1	S. Russell, P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall Series in AI, 2009.
2	G. Luger, "Artificial Intelligence, Structures and strategies for Complex Problem Solving", Addison Wesley, 2009.
3	M. Lutz, "Learning Python 5ed", O'Reilly, 2009.
4	T. Rashid, "Make Your Own Neural Network", CreateSpace Independent Publishing Platform, 2016.
5	H. Geng, "Internet of Things and Data Analytics Handbook", Wiley, 2016.

Number of classes of active education per week during semester/trimester/year

Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	1	1		

Teaching methods	Lectures, Practical classes, Laboratory classes, Consultations

Grade (maximum number of points 100)

Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures	10	**Written exam**	40
Exercises	20	**Oral exam**	30
Colloquia			
Projects			

Specification for the book of courses

Study program	Control Systems		
Module	Common		
Type and level of studies	Master studies		
The name of the course	Electrical Drive Control		
Lecturer (for lectures)	Mitić B. Darko, Nikolić S. Saša		
Lecturer/associate (for exercises)	Danković B. Nikola		
Lecturer/associate (for OFE)			
Number of ECTS	5	**Course status (obligatory/elective)**	Obligatory

Prerequisites	
Course objectives	Introduction to different types of controllers, control of electrical drive coordinates, structures of controlled electrical drive, design methods for electrical drive control.
Course outcomes	Knowledge of controllers' types and their application (current, torque, speed and position control), design (method of poles placement, method of symmetric and technical optimum), frequency control of induction motor, vector control.
Course outline	
Theoretical teaching	Definition, significance, application and types of regulated electrical drives. Mechanics of electrical drives (ED). ED kinematics with examples. Generalized model of motor. The regimes of energy transformation. The coordinate transformations. Electromechanical characteristics of motor. DC motors, asynchronous and synchronous motors, step motors. Dynamic characteristics of electromechanical systems. Regulation of electrical drive coordinates (moment, current, speed, position). System: controlled power converter – electrical drive. Typical structures of controlled electrical drive. Methods for design of electrical drive control. Classical methods. Modern methods. Control of a DC motor using linear controllers. The selection of the type of linear controller and its parameters tuning. Control of asynchronous motor. Frequency control of asynchronous motor speed. The principle of field-oriented vector control. Design of identity observer. Control based on state space coordinates.
Practical teaching (exercises, OFE, study and research work)	Modeling of ED using Hamilton's principle and Lagrange-Euler equations. Time responses of EDs. Regulation of DC motor position and speed using linear (PI, PD and PID) controllers. The selection of the type of linear controller and practical tuning of its parameters. Control of asynchronous motor. Frequency control of asynchronous motor speed. Asynchronous motor control based on PLC and frequency controllers. Vector control of asynchronous motors. Implementation of ED in the automotive industry. ABS, ESL, ESC, servo systems in modern vehicles.
Textbooks/references	
1	V. Vučković, “Electrical Drives“, Akademska misao, 2002. (in Serbian)
2	I. Boldea, S.A. Nasar: “Vector Control of AC Drives“, CRC Press, 1992.
3	W. Leonhard: “Control of Electrical Drives“, Springer-Verlag, 1996.
4	Dragan Antić, Darko Mitić, Zoran Jovanović, "Electrical drive control - workbook", Faculty of Electronic Engineering, Niš, 2010. (in Serbian)
5	

Number of classes of active education per week during semester/trimester/year

Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	2	0		

Teaching methods	Lectures; Auditory exercises; Computer exercises; Consultations

Grade (maximum number of points 100)

Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures		**Written exam**	20
Exercises		**Oral exam**	20
Colloquia	60		
Projects			

Specification for the book of courses

Study program	Control Systems		
Module	Common		
Type and level of studies	Master studies		
The name of the course	Professional Practice		
Lecturer (for lectures)	Head of study programme		
Lecturer/associate (for exercises)			
Lecturer/associate (for OFE)			
Number of ECTS	3	**Course status (obligatory/elective)**	Obligatory

Prerequisites	
Course objectives	Get to know the process of work in the company in which the professional practice is carried out, its goals and organizational units. Getting to know the team and the project to which the student is involved in his professional practice, selected in accordance with the student's elective area (module) for which the student has decided. Understanding the process of work in an enterprise, business processes, understanding of work risks, participation in design, documentation preparation or quality control, in accordance with the work process and the possibilities of the work environment.
Course outcomes	Improving students' ability to get involved in the work process upon completion of studies. Developing responsibility, professional approach to work, communication skills in the team. Complementing the theoretical knowledge acquired within the study program and practical knowledge of the issues that are being studied in the course of studies that the student attends. Using the experience of professionals working in an institution where the practice is carried out to expand the practical knowledge and motivation of students. To gain a clear insight into the possibility of applying the acquired knowledge and skills covered by the study program in practice.
Course outline	
Theoretical teaching	
Practical teaching (exercises, OFE, study and research	The content of the professional practice is in full compliance with the objectives of the practice. The student learns the structure of the company and the goals of its business, adjusts its own engagement to the study area for which it has determined and duly fulfills its work obligations in accordance with the duties of the employees in the company. The student describes his own engagement during professional practice and gives a critical insight in his own experience, knowledge and skills gained in practice.
Textbooks/references	
1	
2	
3	
4	
5	

Number of classes of active education per week during semester/trimester/year

Lectures	Exercises	OFE	Study and research work	Other classes
				6

Teaching methods	As a rule, the student chooses an individual from a state, private or public sector in which he / she will perform the professional practice. Professional practice can also be done abroad, in which case the student improves, among other things, a foreign language. On the proposal of the student, the head of the electoral area-module approves the practice in the desired institution and, on request, issues a written instruction for professional practice to a person in charge of practicing in the given institution. According to the practice, and based on the student's report and the confirmation of the responsible person who confirms that the practice has been done, the student is awarded 3 ESPB points for the completed professional practice.

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points
Activity during lectures		Written exam	
Exercises	70	Oral exam	30
Colloquia			
Projects			

Specification for the book of courses

Study program	Control Systems		
Module	Common		
Type and level of studies	Master studies		
The name of the course	Study and Research Work		
Lecturer (for lectures)			
Lecturer/associate (for exercises)			
Lecturer/associate (for OFE)			
Number of ECTS	3	**Course status (obligatory/elective)**	Obligatory

Prerequisites	
Course objectives	Application of basic, theoretical-methodological, scientific-professional and expert-applied knowledge and methods to solve concrete problems. The student studies the problem, its structure and complexity, and on the basis of conducted analyzes, concludes the possible ways of solving it. By studying literature students are introduced to methods that are designed for solving similar tasks and engineering practice in their solving.
Course outcomes	Training students to independently apply previously acquired knowledge from different areas they have studied to examine the structure of the given problem and its systemic analysis in order to draw conclusions about possible directions of its resolution. Through self-use of literature, students expand their knowledge by studying various methods and papers related to similar issues. In this way, students develop the ability to conduct analyzes and identify problems within the given issues. Practical application of acquired knowledge among students develops the ability to see the place and role of engineers in the selected area, the need for cooperation with other professions and teamwork.
Course outline	
Theoretical teaching	It is formed individually in accordance with the needs of a concrete graduate-master work, its complexity and structure. According to his affinities and preferences, the student chooses the field of study work or the subject teacher from the list of teachers in the study program, which defines the specific task. The student studies professional literature, professional and scientific papers dealing with similar topics, performs analyzes in order to find a solution for a concrete task, or perform certain experiments in the laboratory. The study includes active monitoring of primary knowledge, organization and performance of experiments, numerical simulations and statistical data processing, preparation of seminar work from the narrow scientific-scientific field, which is the topic of independent research work.
Practical teaching (exercises, OFE, study and research	
Textbooks/references	
1	
2	
3	
4	
5	

Number of classes of active education per week during semester/trimester/year

Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
			6	

Teaching methods	

Grade (maximum number of points 100)

Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures		**Written exam**	
Exercises		**Oral exam**	50
Colloquia			
Projects	50		

Specification for the book of courses

Study program	Control Systems		
Module	Common		
Type and level of studies	Master studies		
The name of the course	Master Thesis – Study and Research Work		
Lecturer (for lectures)			
Lecturer/associate (for exercises)			
Lecturer/associate (for OFE)			
Number of ECTS	4	**Course status (obligatory/elective)**	Obligatory

Prerequisites	
Course objectives	Application of basic, theoretical-methodological, scientific-professional and applied knowledge and methods to solve concrete problems. The student studies the problem, its structure and complexity, and on the basis of the conducted analysis, concludes the possible ways of solving it. By studying literature students are introduced to methods and engineering practice for solving similar tasks.
Course outcomes	Training students to independently apply previously acquired knowledge from different areas they have studied to examine the structure of the given problem and its systemic analysis in order to draw conclusions about possible directions of its resolution. Through self-use of literature, students expand their knowledge by studying various methods and papers related to similar issues. In this way, students develop the ability to conduct analyzes and identify problems within the given issues. Practical application of acquired knowledge among students develops the ability to see the place and role of engineers in the selected area, the need for cooperation with other professions and teamwork.
Course outline	
Theoretical teaching	It is formed individually in accordance with the needs of a concrete graduate-master work, its complexity and structure. According to his affinities and preferences, the student chooses the field of study work or the subject teacher from the list of teachers in the study program, which defines the specific task. The student studies professional literature, professional and scientific papers dealing with similar topics, performs analyzes in order to find a solution for a concrete task, or perform certain experiments in the laboratory. The study includes active monitoring of primary knowledge, organization and performance of experiments, numerical simulations and statistical data processing, preparation of seminar work from the narrow scientific-scientific field, which is the topic of independent research work.
Practical teaching (exercises, OFE, study and research	
Textbooks/references	
1	
2	
3	
4	
5	

Number of classes of active education per week during semester/trimester/year

Lectures	Exercises	OFE	Study and research work	Other classes
			7	

Teaching methods	

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points
Activity during lectures		Written exam	
Exercises		Oral exam	50
Colloquia			
Projects	50		

Specification for the book of courses

Study program		Control Systems	
Module		Common	
Type and level of studies		Master studies	
The name of the course		Master Thesis	
Lecturer (for lectures)			
Lecturer/associate (for exercises)			
Lecturer/associate (for OFE)			
Number of ECTS	15	**Course status (obligatory/elective)**	Obligatory
Prerequisites			
Course objectives	The Master's work is aimed at consolidating, validating and practical application of acquired knowledge during Master Academic Studies. The student is given the opportunity to demonstrate the ability to independently perform a project, which can be practical, research or theoretical-methodological character. The student also acquires experience in presenting his work through written form and oral presentation during the defense of work.		
Course outcomes	Ability to lead a standalone project, the ability to formulate and analyze problems, critically review possible solutions, review literature from the given area. Application of acquired engineering and design skills and problem solving skills, given the complexity, cost, reliability and efficiency of the solution. Ability to write work in a given form. Ability to clearly explain the project through an oral defense of work.		
Course outline			
Theoretical teaching	Master work is the independent research, practical or theoretical methodological work of the student in accordance with the level of studies, in which he becomes acquainted with a certain area through a literature review and adopts methodology of research, ie design, necessary for the production of work. By making the work, the student applies the practical and theoretical knowledge acquired during the studies. In written form, as a rule, the paper contains an introductory chapter, a definition of the problem, an overview of the areas and existing solutions, a proposal and a description of the solution, the conclusion and the literature. A public oral defense of work is organized before a commission of three members, one of which is a mentor of work. During the oral defense, the candidate explains the results of his work, and then answers the questions of the members of the commission, whereby the candidate demonstrates the ability to oral presentation of his project.		
Practical teaching (exercises, OFE, study and research			
Textbooks/references			
1			
2			
3			
4			
5			

Number of classes of active education per week during semester/trimester/year				
Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
Teaching methods				

Grade (maximum number of points 100)			
Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures		**Written exam**	70
Exercises		**Oral exam**	30
Colloquia			
Projects			