Specification for the book of courses

Study program	Control Systems / Automatic Control		
Type and level of studies	Master Academic 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	None
Course objectives	Principles of functioning and design of systems possessing intelligence in communication with the environment, especially with humans.
Course outcomes	Understanding the motives for conceiving machines based on artificial intelligence principles, from the standpoint of perception, cognition, and execution. Organization of intelligent machines, especially mobile robots.
Course outline	
Theoretical teaching	Definitions of intelligent systems and subsystems with a focus on robotic systems. Robot locomotion, specifically mobile robots, robotic arms, and complex robotic systems like humanoid robots. Sensors and perception in robotics with the application of artificial intelligence algorithms. Robot movement based on perception with a special focus on human-robot and robot-environment interaction. Robot motion planning in human interaction, including verbal and non-verbal communication, as well as physical human-robot interaction.
Practical teaching (exercises, OFE, study and research work)	Simulation environments for research and development in the field of intelligent machines. Display of mobile robot movement simulations in various environments. Implementation of algorithms for human-robot interaction. Presentation of available data for training intelligent machines.
Textbooks/references	
1	B. Siciliano, O. Khatib, "Springer Handbook of Robotics", Springer, 2016, ISBN: 9783319325507
2	S.M. LaValle, "Planning Algorithms", Cambridge University Press, 2006, ISBN: 9780521862059
3	O. Simeone, "Machine Learning for Engineers", Cambridge University Press, 2022, ISBN: 9781316512821
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	0	0

Teaching methods	Multimedia lectures; Auditory and demonstration exercises

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			
Projects	50		

Specification for the book of courses

Study program	Control Systems / Automatic Control		
Type and level of studies	Master Academic 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	None
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 work)	Elaboration of methodological units of theoretical instruction using concrete examples and problems, with intensive use of the MATLAB Control Toolbox as a significant aid in the analysis, design, and simulation of digital control systems. The following project tasks will be considered: design of a digital PI controller for a velocity servosystem through emulation, design of a digital integral compensator for a velocity servosystem using the Bode method, a positioning servosystem with digital state feedback based on an observed state, and a positioning servosystem with a digital steady-state Kalman state estimator.
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	0	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	20	Oral exam	20
Colloquia	0		
Projects	30		

Specification for the book of courses

Study program	Control Systems / Automatic Control
Type and level of studies	Master Academic Studies
The name of the course	Flexible Production Systems
Lecturer (for lectures)	Nikolić S. Saša, Danković B. Nikola
Lecturer/associate (for exercises)	Đorđević D. Anđela
Lecturer/associate (for OFE)	

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

Prerequisites	None
Course objectives	Introduction to manufacturing systems and their comparison. Cellular manufacturing systems and their application. Application of computer integrated manufacturing (CIM), advantages and disadvantages.
Course outcomes	Knowledge of production technologies, their advantages and disadvantages. Ability to follow trends in modern production systems. Development of own production techniques, as well as quality control in flexible production systems in simulation and real environments.

Course outline

Theoretical teaching	Introduction to industrial production. What are production lines, production methods, continuous production, flexible production systems (FPS). Historical development of flexible production systems. Types of flexible production systems. Flexibility levels. Control of flexible production system. Configuration of flexible production systems. Industrial robots, cobots. 3D printing. CNC machines. Examples and applications of FPS in the automotive, wood, textile, electronics, pharmaceutical industries. Software tools for FPS simulation. Production process and waste reduction. Quality assurance and control, tolerances.
Practical teaching (exercises, OFE, study and research work)	Use of software tools that enable simulation of factory scenes with flexible manufacturing systems (I/O Factory, Arena, Techomatix Plant Simulation, FlexSim, Visual Components). Introduction to the operation of CNC machines and 3D printing.

Textbooks/references

1	S. Makris, "Cooperating Robots for Flexible Manufacturing", Springer, 2020.
2	A. Gola, "Design and Management of Manufacturing Systems", MDPI, 2021.
3	J. Beier, "Simulation approach towards energy flexible manufacturing systems", Springer, 2017.
4	I. Gibson, D. Rosen, B. Stucker, "Additive Manufacturing Technologies", Springer, 2015.
5	T. Tolio, "Design of flexible production systems : methodologies and tools", Springer, 2009.

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

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

Teaching methods	Lectures, use of modern simulation software tools and existing equipment, independent work of students on homeworks and projects, student seminars (presentations of student papers with 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 / Automatic Control	
Type and level of studies			Master Academic Studies	
The name of the course			Modelling and Simulation in Automotive Industry	
Lecturer (for lectures)			Antić S. Dragan, Milojković T. Marko, Perić Lj. Staniša	
Lecturer/associate (for exercises)			Milojković T. Marko, Perić Lj. Staniša, Sibinović D. Vladimir	
Lecturer/associate (for OFE)				
Number of ECTS		5	**Course status (obligatory/elective)**	Elective
Prerequisites	None			
Course objectives	The course aims to apply students' existing knowledge of the basics of mechanics and modeling and simulation of dynamic systems to vehicles, and in particular to vehicle subsystems, the vehicle in motion, and vehicle handling. The key to the course is an understanding of the various dynamic equations of vehicle behavior during motion, as well as their computer simulation.			
Course outcomes	At the end of the course, students will be able to: model the dynamics of vehicle subsystems and provide basic recommendations for the design and improvement of the functions of these subsystems based on the performed computer simulations; develop models of lateral and longitudinal vehicle dynamics, as well as vehicle behavior in motion; apply basic simulation techniques to the analysis of vehicle dynamic behavior, including validation.			
Course outline				
Theoretical teaching	Introduction to the basic mathematical and mechanical concepts relevant to the vehicle dynamics analysis. Modeling and simulation of vehicle subsystems: wheels; servo; suspension; transmission; engine. Modeling and simulation of vehicles in motion: vehicle/driver interaction, vehicle vibrations (frequencies, damping), suspension behavior of quarter, half and full car models, design and practical issues (damping, chassis); road influence and human response. Modeling and simulation of vehicle handling: steering, modeling and simulation of tires, forces and moments. Modeling and simulation of ABS and ESP systems. Graphical methods of vehicle modeling. Case studies of modeling and simulation of vehicles in motion and vehicle handling.			
Practical teaching (exercises, OFE, study and research work)	Introduction to Matlab software environment related to the automotive industry. Modeling and simulation of wheel subsystems. Modeling and simulation of steering subsystems. Modeling and simulation of suspension subsystems. Modeling and simulation of transmission subsystems. Modeling and simulation of vehicle engines. Modeling and simulation of vehicle steering. Quarter car model. Modeling and simulation of ABS systems. Modeling and simulation of ESP systems.			
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	0	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**	30
Exercises			**Oral exam**	30
Colloquia				
Projects		30		

Specification for the book of courses

Study program	Control Systems / Automatic Control Electrical Power Engineering Electron Devices and Microsystems Electronics and Embedded Systems		
Type and level of studies	Master Academic Studies		
The name of the course	Methods of mathematical optimization		
Lecturer (for lectures)	Marinković D. Slađana, Rančić Z. Lidija		
Lecturer/associate (for exercises)	Rajković P. Jovan		
Lecturer/associate (for OFE)			
Number of ECTS	5	**Course status (obligatory/elective)**	Obligatory / Elective

Prerequisites	None
Course objectives	Mastering basic mathematical knowledge from optimization theory and getting acquainted with various optimization methods. Training for forming mathematical models of problems from practice and solving them.
Course outcomes	Students' capability to apply acquired knowledge in the profession. Ability to recognize optimization problems from practice, define them, form mathematical models, select appropriate methods for their solution and apply methods using software tools.
Course outline	
Theoretical teaching	Defining a general optimization problem. Theoretical foundations of optimization. Elements of convex analysis. Linear programming. Geometric interpretation of linear programming problems. Duality principle. Simplex method. One-dimensional optimizations. Unconstrained multidimensional optimizations. Search methods. Gradient methods. Constrained multidimensional optimizations. Kuhn-Tucker conditions. Method of Lagrange multipliers. Penalty function methods. Fundamentals of multiobjective optimization.
Practical teaching (exercises, OFE, study and research work)	Solving tasks that follow the content presented in the theoretical classes. Implementation of optimization algorithms through software packages for symbolic computation. Through the preparation of homework assignments and the analysis of their solutions, the application of mathematical and software tools in the context of optimization is gradually mastered.
Textbooks/references	
1	E.K.P. Chong, S.H. Zak, An Introduction to Optimization, John Wiley & Sons, 2001.
2	X.S. Yang, Introduction to Mathematical Optimization, Cambridge International Science Publishing, 2008.
3	M.J. Kochenderfer, T.A. Wheeler, Algorithms for Optimization, second edition, The MIT Press, 2025.
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	0	0

Teaching methods	Lectures, computational exercises, computer exercises, project.

Grade (maximum number of points 100)

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

Specification for the book of courses

Study program		Control Systems / Automatic Control		
Type and level of studies		Master Academic Studies		
The name of the course		Sensors and Transducers in Vehicles		
Lecturer (for lectures)		Dinčić R. Milan, Denić B. Dragan		
Lecturer/associate (for exercises)		Miljković S. Goran		
Lecturer/associate (for OFE)		Pešić T. Miroljub		
Number of ECTS	5	**Course status (obligatory/elective)**	Elective	
Prerequisites	None			
Course objectives	Gaining comprehensive knowledge of the design, implementation, networking, and application of sensor systems in modern vehicles.			
Course outcomes	Students will acquire theoretical and practical knowledge about the types, operating principles, implementation, and application of sensors in automobiles and vehicles.			
Course outline				
Theoretical teaching	Types of Sensors in Vehicles, Development Trends, Manufacturing Technologies, MEMS Sensors. Functional sensors in automobiles, safety sensors, monitoring sensors. Position sensors, force and torque sensors, pressure sensors, flow meters, temperature sensors, gas and concentration sensors. Actuators in Vehicles. Sensor signal processing. Data exchange between automotive electronic systems. Connecting sensors and actuators to the central computing system in the vehicle. Main requirements and development directions of sensors and actuators in the automotive industry. Sensors in Autonomous and Electric Vehicles.			
Practical teaching (exercises, OFE, study and research work)	Tutorials, problem-solving exercises, laboratory exercises, preparation of seminar papers and project assignments, practical implementation of sensor systems.			
Textbooks/references				
1	"Bosch Automotive Electrics and Automotive Electronics", 5th edition, Springer, 2014.			
2	S. Bhattacharya, A. K. Agarwal, O. Prakash, S. Singh, ed., "Sensors for Automotive and Aerospace Applications", Springer, 2019.			
3	J. Marek, H.-P. Trah, Y. Suzuki, I. Yokomori, "Sensors applications, volume 4 - Sensors for Automotive Applications", John Wiley and Sons, 2003.			
4	W. Ribbens, "Understanding Automotive Electronics", 8th edition, Elsevier, 2017.			
5	"Bosch Automotive Handbook", Wiley, 2022.			
Number of classes of active education per week during semester/trimester/year				
Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	1	1	0	0
Teaching methods	Lectures, tutorials, problem-solving exercises, laboratory exercises, project assignments and seminar papers, 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				

<table>
<tr><th colspan="4">Specification for the book of courses</th></tr>
<tr><td colspan="2">Study program</td><td colspan="2">Computer Science and Informatics / Computer Systems Security
Computer Science and Informatics / Data Engineering
Computer Science and Informatics / Information Systems and Technologies
Computer Science and Informatics / Software Engineering
Control Systems / Automatic Control</td></tr>
<tr><td colspan="2">Type and level of studies</td><td colspan="2">Master Academic Studies</td></tr>
<tr><td colspan="2">The name of the course</td><td colspan="2">Geospatial Information Systems</td></tr>
<tr><td colspan="2">Lecturer (for lectures)</td><td colspan="2">Stojanović H. Dragan, Predić B. Bratislav</td></tr>
<tr><td colspan="2">Lecturer/associate (for exercises)</td><td colspan="2">Predić B. Bratislav</td></tr>
<tr><td colspan="2">Lecturer/associate (for OFE)</td><td colspan="2"></td></tr>
<tr><td>Number of ECTS</td><td>6</td><td>Course status (obligatory/elective)</td><td>Obligatory / Elective</td></tr>
<tr><td>Prerequisites</td><td colspan="3">None</td></tr>
<tr><td>Course objectives</td><td colspan="3">Mastering the knowledge, methods, and technologies necessary for the design and implementation of geospatial information systems (GIS) and applications, as well as the application of spatial data science.</td></tr>
<tr><td>Course outcomes</td><td colspan="3">Theoretical and practical knowledge of the principles, methods, software tools, libraries, and frameworks for the development of geospatial information systems (GIS) and applications in spatial data science.</td></tr>
<tr><td colspan="4">Course outline</td></tr>
<tr><td>Theoretical teaching</td><td colspan="3">Introduction to Geospatial Information Systems (GIS). Geospatial coordinate systems. Methods and systems for positioning and collecting geospatial data: GPS, remote sensing, aerial and orthophoto imaging, RADAR, LIDAR, conversion of existing data, OpenStreetMap (OSM), etc. Raster representation of geospatial data, formats, and processing functions. Vector representation of geospatial data, formats, functions, and algorithms for their processing and analysis. Geospatial databases. Indexing structures and methods for accessing geospatial data. Time in GIS and management of spatiotemporal data. Visualization of geospatial data, interaction methods, and visual analytics. Analysis of geospatial data and spatial data science. Analysis of mobile data, trajectories, spatial networks – mobility data science. Processing and analysis of large geospatial data sets. Specifications and standards in geospatial data and GIS (OGC, ISO TC 211). Web GIS and OGC-specified GI services (WMS, WFS, WCS, WPS, etc.). Mobile GIS and location-based services.</td></tr>
<tr><td>Practical teaching (exercises, OFE, study and research work)</td><td colspan="3">Basic Functions and Components of GIS (QGIS, ArcGIS Pro). Data representation in different coordinate systems. Methods and technologies for managing geospatial data in GIS. Application of libraries and functions for processing and analyzing raster data (GDAL, rasterio). Application of libraries and functions for processing and analyzing vector data (GEOS, shapely). Design and implementation of geospatial databases (PostGIS/PostgreSQL). Application of indexing structures in processing geospatial queries (PostGIS). Processing and analysis of spatiotemporal data and GIS. Visualization and visual analysis of geospatial data (Leafmap, Folium, etc.). Geospatial data analysis and implementation of spatial data science (SAGA, GeoPandas, PySal). Mobility and trajectory data analysis (MovingPandas, scikit-mobility). Systems for processing and analyzing large geospatial data (GeoSpark, Sedona, Mosaic). Implementation and application of OGC Web GIS services (GeoServer, pygeoapi). Development of Web GIS applications using libraries and frameworks (Leaflet, OpenLayers). Development of mobile GIS applications and location-based services on Android/iOS platforms.</td></tr>
<tr><td colspan="4">Textbooks/references</td></tr>
<tr><td>1</td><td colspan="3">Kang-tsung Chang, Introduction to Geographic Information Systems, 9th Edition, McGraw-Hill Science, 2019</td></tr>
<tr><td>2</td><td colspan="3">Matt Duckham, Qian (Chayn) Sun, Michael F. Worboys, GIS: A Computing Perspective, ,3rd edition, CRC Press, 2024.</td></tr>
<tr><td>3</td><td colspan="3">Michael Dorman, Anita Graser, Jakub Nowosad, Robin Lovelace, Geocomputation with Python, Chapman and Hall/CRC, 2025.</td></tr>
<tr><td>4</td><td colspan="3">Michael Dorman, Introduction to Web Mapping, Chapman and Hall/CRC, 2020.</td></tr>
<tr><td>5</td><td colspan="3">Shashi Shekhar, Sanjay Chawla, Spatial Databases: A Tour, Pearson; 1st edition, 2003</td></tr>
<tr><td colspan="4">Number of classes of active education per week during semester/trimester/year</td></tr>
</table>

Lectures	Exercises	OFE	Study and research work	Other classes
2	2	0	0	0
Teaching methods	Lectures, exercises, 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**	
Exercises			**Oral exam**	40
Colloquia		40		
Projects		20		

Specification for the book of courses

Study program			Control Systems / Automatic Control Control Systems / Computer Control Systems and Measurement Techniques	
Type and level of studies			Master Academic Studies	
The name of the course			Digital Image Processing	
Lecturer (for lectures)			Nikolić V. Saša, Cvetković S. Stevica	
Lecturer/associate (for exercises)			Cvetković S. Stevica	
Lecturer/associate (for OFE)			Cvetković S. Stevica	
Number of ECTS		5	**Course status (obligatory/elective)**	Obligatory / Elective
Prerequisites	None			
Course objectives	Present basic algorithms for digital image processing: quality improvement, sharpening, filtering, segmentation, etc. Master the mathematical apparatus for applying operations in digital image processing. Implement the acquired knowledge in software in Matlab.			
Course outcomes	To enable students to understand and independently implement basic digital image processing operations in Matlab or Python.			
Course outline				
Theoretical teaching	Components of an image processing system. Photometry, image acquisition and digitization. Image enhancement in the spatial domain. Image histogram. Linear filtering in the spatial domain - image sharpening. Fast image filtering in the frequency domain - convolution theorem. Nonlinear image filtering - an example of a median filter. Image restoration in the presence of noise. Image segmentation - comparison with a threshold. Morphological operations on an image. Color image processing.			
Practical teaching (exercises, OFE, study and research work)	Computer exercises in the Matlab and Python software packages. Practical program implementation of digital image processing algorithms presented in lectures. Working with matrices, scripts, functions and flow control. Loading and displaying images, pixel analysis and data types. Techniques for improving image quality are covered - contrast, gamma correction and histogram. Spatial and frequency filtering, as well as edge detection methods. Segmentation, morphological operations, and color image processing are also covered. The goal is to master the most important image processing algorithms in Matlab and Python.			
Textbooks/references				
1	Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, 3rd edition, Prentice-Hall, 2008.			
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**
2	1	1	0	0
Teaching methods	Lectures, auditory exercises, laboratory exercises			
Grade (maximum number of points 100)				
Pre-exam duties		**Points**	**Final exam**	**Points**
Activity during lectures		5	**Written exam**	
Exercises		5	**Oral exam**	40
Colloquia		50		
Projects				

Specification for the book of courses

Study program	Control Systems / Automatic Control Electron Devices and Microsystems		
Type and level of studies	Master Academic Studies		
The name of the course	Energy storage systems in modern propulsion units		
Lecturer (for lectures)	Aleksić M. Sanja		
Lecturer/associate (for exercises)	Spasić D. Miodrag		
Lecturer/associate (for OFE)	Branković Lj. Neda		
Number of ECTS 5	**Course status (obligatory/elective)**	Obligatory / Elective	

Prerequisites	None
Course objectives	The aim of this course is to introduce students to the working principles and fundamental characteristics of electric and hybrid electric vehicles (EVs and HEVs). It familiarizes them with the electrochemical foundations of battery systems and supercapacitors, battery management systems, as well as charging and discharging methods for returning electrical energy to the system. The course equips students to test and simulate battery module characteristics using the MATLAB/Simulink software environment, and to understand, analyze, and optimize battery performance.
Course outcomes	Students are trained to recognize different types of power supply devices, as well as the possibilities of combining them to optimize energy consumption in EVs and HEVs. They are able to define the conditions for establishing feedback for charging EVs and HEVs during phases of their operating cycles when this is possible, test, simulate, and optimize battery module characteristics in MATLAB, design battery systems for specific types of vehicles, analyze real battery performance, and optimize power supply systems within the MATLAB/Simulink environment.
Course outline	
Theoretical teaching	Hybrid and electric vehicles and their environmental impacts. Energy storage systems and hybrid energy storage systems. Operating principles of lithium-ion and other types of batteries, as well as hydrogen fuel cells. Performance parameters: capacity, energy density, lifespan. Advantages and disadvantages of various battery types. Battery monitoring and protection. Thermal management and safety aspects. Cell charging and balancing models. Supercapacitors (operating principle, types, chemical and electrical characteristics, comparison with batteries). Hydrogen. Characteristics of hydrogen combustion (reactivity issues). Hydrogen storage. Performance, efficiency, economic and environmental benefits of using hydrogen fuel cells. Transistors for converters (conventional and WBG as the future). Converter control.
Practical teaching (exercises, OFE, study and research work)	Introduction to energy storage systems. Overview of technologies – batteries, supercapacitors, flywheels, hydrogen. Simulation of lithium-ion battery models in Simulink. Creation and parameterization of cell and battery pack models. Charging and discharging of batteries – real-time analysis. Supercapacitors: modeling and analysis. Hybrid storage systems (Battery + SC). Energy management in electric vehicles. Thermal battery model, heating simulation. Battery diagnostics and degradation. Status and simulation of chargers (AC/DC, DC/DC). Simulation of Level 1/2 chargers, conversion and control. Integration with Smart Grid concepts (V2G, BMS, EMS).
Textbooks/references	
1	Electrochemical Energy Storage for Renewable Sources and Grid Balancing, Jürgen Garche et al. Springer, 2015.
2	Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, Chris Mi, M. Abul Masrur, David Wenzhong Gao, Wiley, 2011.
3	Batteries for Electric Vehicles: Materials and Electrochemistry, D. A. J. Rand, R. Woods, R. M. Dell, Royal Society of Chemistry, 2001.
4	Advanced Electric Drive Vehicles, A. Emadi, CRC Press, 2014.
5	Internal scripts and lectures by the instructors are available on the course website.

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

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

Teaching methods	The teaching is carried out by combining lectures, computer and laboratory exercises, with an emphasis on an interactive approach and practical application of knowledge. Theoretical teaching uses modern visual aids to introduce students to the architecture of electric and hybrid vehicles, the electrochemical foundations of batteries and supercapacitors, as well as management systems (BMS) and regenerative charging methods. In computer exercises, students develop models for testing, simulating and optimizing the performance of battery modules through independent work in the MATLAB/Simulink software environment. The learning process is rounded off by the development of project tasks and regular consultations, which equips students with the ability to analyze and solve real engineering problems in the field of energy storage.		

Grade (maximum number of points 100)			
Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures	5	**Written exam**	20
Exercises	15	**Oral exam**	30
Colloquia			
Projects	30		

Specification for the book of courses

Study program		Control Systems / Automatic Control Control Systems / Computer Control Systems and Measurement Techniques		
Type and level of studies		Master Academic Studies		
The name of the course		Computer Control Systems		
Lecturer (for lectures)		Jovanović D. Zoran, Spasić D. Miodrag		
Lecturer/associate (for exercises)		Spasić D. Miodrag, Perić Lj. Staniša		
Lecturer/associate (for OFE)		Sibinović D. Vladimir, Mitić M. Vladimir		
Number of ECTS	6	**Course status (obligatory/elective)**	Obligatory / Elective	

Prerequisites	None
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 work)	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	M. Sami Fadali, A. Visioli, "Digital Control Engineering: Analysis and Design", Academic Press (Elsevier), 2019.
5	A. Veloni, N. Miridakis, "Digital Control Systems: Theoretical Problems and Simulation Tools" CRC Press, 2017.

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

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

Teaching methods	Lectures, classroom exercises, computer exercises

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 / Automatic Control Control Systems / Computer Control Systems and Measurement Techniques	
Type and level of studies		Master Academic Studies	
The name of the course		Reinforcement Learning in Control Systems	
Lecturer (for lectures)		Milojković T. Marko, Milovanović B. Miroslav	
Lecturer/associate (for exercises)		Milojković T. Marko, Milovanović B. Miroslav	
Lecturer/associate (for OFE)		Perić Lj. Staniša, Milovanović B. Miroslav, Spasić D. Miodrag	
Number of ECTS	6	**Course status (obligatory/elective)**	Obligatory / Elective

Prerequisites	
Course objectives	The aim of the course is for students to acquire basic theoretical and practical knowledge in the field of reinforcement learning and its applications in systems control, with a special focus on simulation environments and autonomous systems. Through the real-world examples and implementation of reinforcement learning algorithms, students will learn how agents are trained through reward and punishment, how appropriate algorithms are selected, and how they are applied in modern applications.
Course outcomes	Upon completion of the course, the student will gain an understanding of the basic concepts of reinforcement learning and its applications in modern control systems. They will be able to formulate simple control problems in a form suitable for the application of reinforcement learning algorithms, as well as to apply basic methods for training agents in simulated environments. They will understand the role of reward, state, action and policy in the decision-making process. The student will be able to implement and test simple models in the Python programming language, using custom libraries and simulation tools. In addition, they will be able to interpret the obtained results, evaluate the performance of agents and propose improvements. They will apply the acquired knowledge in solving practical tasks in the field of intelligent control, such as control in industrial environments and simulation of the behavior of autonomous systems.
Course outline	
Theoretical teaching	Introduction to reinforcement learning and its applications in control systems. Markov decision processes (MDP) and optimization fundamentals. Q-learning algorithm. Deep Q-Networks (DQN) – value approximation using neural networks. Policy Gradient methods. Actor-Critic methods and the advantages of a combined approach. Exploitation and exploration in the context of control. Generalization, stability and overfitting in reinforcement learning. Applications of reinforcement learning in engineering problems. Introduction to simulation frameworks and OpenAI Gym. Basics of working with the CARLA simulator and its applications. Application of reinforcement learning in autonomous vehicle control simulation.
Practical teaching (exercises, OFE, study and research work)	Practical teaching is implemented through laboratory exercises in the Python programming language, using tools such as Google Colab, OpenAI Gym and CARLA simulator. Students will implement basic reinforcement learning algorithms through specific tasks, test them in simulated environments and analyze the results. The goal is to develop intuition, understand the functioning of agents and apply theoretical knowledge in solving practical management problems.
Textbooks/references	
1	Richard S. Sutton, Andrew G. Barto – Reinforcement Learning: An Introduction, Second Edition, MIT Press, 2018.
2	Laura Graesser, Wah Loon Keng – Foundations of Deep Reinforcement Learning: Theory and Practice in Python, Addison-Wesley, 2019.
3	Maxim Lapan – Deep Reinforcement Learning Hands-On, Second Edition, Packt Publishing, 2020.
4	Csaba Szepesvári – Algorithms for Reinforcement Learning, Morgan & Claypool Publishers, 2010.
5	Lucian Busoniu, Robert Babuska, Bart De Schutter – Reinforcement Learning and Dynamic Programming Using Function Approximators, CRC Press, 2010.

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

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

Teaching methods	Teaching is conducted through lectures and interactive exercises, with demonstrations and work on specific tasks in the Python programming environment. Students actively participate in problem solving, simulations, and implementation of reinforcement learning algorithms.		
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	Control Systems / Automatic Control Control Systems / Computer Control Systems and Measurement Techniques		
Type and level of studies	Master Academic Studies		
The name of the course	Electrical Drive Control		
Lecturer (for lectures)	Antić S. Dragan, Mitić B. Darko, Nikolić S. Saša		
Lecturer/associate (for exercises)	Mitić B. Darko, Nikolić S. Saša, Danković B. Nikola		
Lecturer/associate (for OFE)			
Number of ECTS	5	**Course status (obligatory/elective)**	Obligatory / Elective

Prerequisites	None
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	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 (ED) coordinates. System: controlled power converter – ED. Typical structures of ED control. Methods for design of ED 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. Design of state feedback control.
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	I. Boldea, S.A. Nasar, *Vector Control of AC Drives* , CRC Press, 1992.
2	W. Leonhard, *Control of Electrical Drives* , Springer-Verlag, 1996.
3	Adel Merabet (Ed.), *Advanced Control Systems for Electric Drives* , MDPI, 2020.
4	Tian-Hua Liu (Ed.), *Design and Control of Electrical Motor Drives* , MDPI, 2021.
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	0	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		**Oral exam**	30
Colloquia	40		
Projects			

Specification for the book of courses

Study program	Control Systems		
Type and level of studies	Master Studies		
The name of the course	Professional Practice		
Lecturer (for lectures)			
Lecturer/associate (for exercises)			
Lecturer/associate (for OFE)			
Number of ECTS	3	**Course status (obligatory/elective)**	Obligatory
Prerequisites			
Course objectives	Familiarization with the work process in the company where the professional internship is conducted, its objectives, and organizational units. Getting to know the team and the project to which the student is assigned within their internship, selected in accordance with the elective study area (module) chosen by the student. Understanding the company's work processes, business operations, awareness of work-related risks, and participation in design, documentation development, or quality control, in accordance with the workflow and the possibilities of the working environment.		
Course outcomes	Enhancing the student's ability to join the workforce upon completion of studies. Developing a sense of responsibility, a professional approach to job, and team communication skills. Supplementing the theoretical knowledge acquired within the study program with practical insight into the issues covered by the student's field of study. Utilizing the experience of professionals employed in the institution where the internship is conducted to broaden practical knowledge and motivate students. Gaining a clear understanding of the applicability of the knowledge and skills acquired through the study program in real-world practice.		
Course outline			
Theoretical teaching			
Practical teaching (exercises, OFE, study and research work)	The content of the professional internship is fully aligned with its objectives. The student becomes familiar with the company's structure and business goals, adapts their engagement to the chosen field of study, and duly fulfills work responsibilities in accordance with the duties of the company's employees. The student describes their own engagement during the internship and provides a critical reflection on their experience, as well as the knowledge and skills acquired during the internship.		
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	The student generally independently selects a company from the public, private, or state sector in which to complete the professional internship. The internship may also be conducted abroad, in which case the student additionally improves their foreign language skills. Upon the student's proposal, the head of the elective field (module) approves the internship in the desired institution and, upon request, issues a written referral for the internship to the person responsible for supervising the internship at the given institution. Upon completion of the internship, based on the student's report and a confirmation issued by the responsible person—signed and stamped by the company—verifying that the internship was completed, the student is awarded 3 ECTS credits for the completed professional internship.

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 / Automatic Control		
Type and level of studies	Master Academic Studies		
The name of the course	Intelligent Control of Mechatronic Systems		
Lecturer (for lectures)	Mitić B. Darko, Perić Lj. Staniša		
Lecturer/associate (for exercises)	Sibinović D. Vladimir, Đorđević D. Anđela		
Lecturer/associate (for OFE)			
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	None
Course objectives	The aim of the course is to enable students to apply modern artificial intelligence techniques in the control of mechatronic systems, with a focus on the design, simulation, optimization, and implementation of intelligent controllers in real-world applications.
Course outcomes	Upon completion of the course, students will be able to design, simulate, and implement intelligent control systems based on fuzzy logic, neural networks, and other AI techniques in mechatronic applications.
Course outline	
Theoretical teaching	Introduction to intelligent mechatronic systems. Architectures of intelligent control systems. Artificial intelligence techniques in mechatronics. Learning methods for intelligent control. Sensors, actuators, and data acquisition in intelligent systems. Fuzzy logic control in mechatronic systems. Adaptive and self-tuning fuzzy control systems. Neural network-based control of mechatronic systems. Reinforcement learning for intelligent control of mechatronic systems. Hybrid strategies of intelligent control. Implementation of intelligent control in embedded systems. Simulation of intelligent control systems. Optimization techniques in the design and control of mechatronic systems.
Practical teaching (exercises, OFE, study and research work)	Simulation of a simple mechatronic system with PID control. Modeling the architecture of an intelligent control system. Comparison of AI techniques in control tasks (regression, classification). Implementation of learning methods (e.g., Q-learning). Processing and visualization of sensor data from a mechatronic system. Design of a fuzzy logic controller in MATLAB. Implementation of an adaptive fuzzy controller. Training a neural network for system identification or control. Reinforcement learning for system stabilization (e.g., pendulum or mobile robot). Design of a hybrid intelligent controller (e.g., sliding mode–ANN). Code generation for a microcontroller – implementation of an intelligent regulator. Simulation of an intelligent control system. Optimization of controller parameters using genetic algorithms.
Textbooks/references	
1	Ganesh R. Naik, "Intelligent Mechatronics", IntechOpen, 2011.
2	Rochdi Merzouki, Arun Kumar Samantaray, Pushparaj Mani Pathak, Belkacem Ould Bouamama, "Intelligent Mechatronic Systems: Modeling, Control and Diagnosis", Springer London, 2012.
3	Shahin Sirouspour, "Advanced Engineering and Computational Methodologies for Intelligent Mechatronics and Robotics", Information Science Reference, 2013.
4	Marcin Szuster, Zenon Hendzel, "Intelligent Optimal Adaptive Control for Mechatronic Systems", Springer International Publishing, 2017.
5	Ivan C. K. Tam, Kolla Bhanu Prakash, Satish Kumar Peddapelli, Vishal Jain, Wai Lok Woo, "Computational Intelligent Techniques in Mechatronics", Wiley, 2024.

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

Lectures	Exercises	OFE	Study and research work	Other classes
2	2	0	0	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	30
Colloquia			
Projects	30		

Specification for the book of courses

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

Prerequisites	None
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	0	0

Teaching methods	Lectures, classroom exercises, computer exercises.

Grade (maximum number of points 100)

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

Specification for the book of courses

Study program	Control Systems / Automatic Control		
Type and level of studies	Master Academic 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	None
Course objectives	The aim of the course is for students to acquire knowledge about vehicle dynamics control and the design of modern automotive control systems. Special emphasis is placed on the application of classical and advanced control algorithms in handling subsystems such as braking, suspension, power steering, and vehicle stability systems.
Course outcomes	Upon completion of the course, students will be able to analyze the behavior of key subsystems and apply appropriate control algorithms. They will be capable of designing and simulating control systems for essential vehicle functions such as braking, stability, power steering, and suspension, using both classical and advanced control techniques.
Course outline	
Theoretical teaching	Introduction to vehicle control and the fundamentals of control engineering systems. The vehicle as a system, influenced by wheel forces and internal loads. Lateral dynamics control. Longitudinal dynamics control. Vertical dynamics control. Application of dynamic control systems. Driver assistance systems in commercial vehicles. Design of control systems for automotive applications. Servo devices (EPS, EHPS). Integrated vehicle control. Braking systems. Introduction to slip control systems (ESP, ESC, DSC, ABS). Design of mathematical models in continuous and discrete domains. Advanced control algorithms (fuzzy logic, neural networks, sliding mode) designed and applied in automotive applications.
Practical teaching (exercises, OFE, study and research work)	Development of a simple input-output model (throttle as input, speed as output); acceleration calculation; simulation of speed control. Examples of PID controller application in EPS systems. ABS modeling. Simulation of coordination between multiple subsystems (e.g., engine + braking). Comparison of PID, fuzzy, and sliding mode algorithms on the same system. Servo steering model with feedback loop. Suspension control based on fuzzy logic rules; simulation of response to uneven road surfaces. Application of a simple artificial neural network for estimating traction or braking force; comparison with a classical model. Integration of multiple modules (EPS + ABS + engine); testing in a defined scenario.
Textbooks/references	
1	Uwe Kiencke, Lars Nielsen, ""Automotive Control Systems: For Engine, Driveline, and Vehicle"", Springer Verlag, 2010.
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	Rolf Isermann, "Automotive Control: Modeling and Control of Vehicles", Springer Berlin, Heidelberg, 2021.
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	0	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	20	**Oral exam**	30
Colloquia			
Projects	20		

Specification for the book of courses

Study program	Control Systems / Automatic Control		
Type and level of studies	Master Academic Studies		
The name of the course	Hydraulic and Pneumatic Control Systems		
Lecturer (for lectures)	Ćirić T. Ivan		
Lecturer/associate (for exercises)	Đorđević D. Anđela		
Lecturer/associate (for OFE)			
Number of ECTS 5	**Course status (obligatory/elective)**	Elective	
Prerequisites	None		
Course objectives	Introducing students to the fundamental principles of analysis and design of modern hydraulic and pneumatic control systems, with a particular focus on their specific characteristics and advantages that make them suitable for application.		
Course outcomes	The ability to solve problems in the field of analysis and development of typical classes of hydraulic and pneumatic control systems.		
Course outline			
Theoretical teaching	Introduction. Energy conversion elements, control and regulation elements, auxiliary elements, sealing. Servo systems. Hydraulic and pneumatic servo systems and their application. Typical nonlinearities of hydraulic and pneumatic systems. Linearization. Basic principles of controlling hydraulic and pneumatic actuators. Electrohydraulic servo valves and servomechanisms. Pneumatic systems. Pressure supply, transmission, and control. Pneumatic valves, compressors, cylinders and motors, pneumatic drive. Control techniques. Application of hydraulic and pneumatic systems in industrial automation.		
Practical teaching (exercises, OFE, study and research work)	Application of computer tools in the analysis and design of hydraulic and pneumatic control systems. Modern methods for experimental model development. Programmable Logic Controllers (PLCs) and their application in the control of hydraulic and pneumatic systems. Examples of hydraulic and pneumatic control systems in automated production, assembly, and packaging lines. Independent development and analysis of typical classes of hydraulic and pneumatic control systems.		
Textbooks/references			
1	Merrit H , Hydraulic Control Systems, John Wiley & Sons Inc , New York, 1991.		
2	Salam, M. A. Fundamentals of Pneumatics and Hydraulics. Springer Nature Singapore, 2022.		
3	Watton G , Fluid Power Systems, Prentice Hall, 1989.		
4	Mirković, R. Hidraulika: Uvod sa primerima upravljanja (2. dopunjeno izd.). Mikro knjiga, 2021.		
5	Uppalaiah, J. Pneumatics and Pneumatic Control: Theory and Practice. Khanna Book Publishing, 2023.		

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

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

Teaching methods	Lectures, exercises, laboratory exercises, homework assignments, colloquia.

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points
Activity during lectures	5	Written exam	
Exercises	5	Oral exam	50
Colloquia			
Projects	40		

Specification for the book of courses

Study program	Control Systems / Automatic Control Control Systems / Computer Control Systems and Measurement Techniques			
Type and level of studies	Master Academic Studies			
The name of the course	Mobile Communication Systems			
Lecturer (for lectures)	Marinković D. Zlatica			
Lecturer/associate (for exercises)	Mladenović M. Ksenija			
Lecturer/associate (for OFE)	Stošić P. Biljana			
Number of ECTS	5	**Course status (obligatory/elective)**	Obligatory / Elective	
Prerequisites	None			
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 communications. 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. Ability of recognizing and discussing possibile applications of mobile communications systems in different fields, such as medicine, IoT systems, etc.			
Course outline				
Theoretical teaching	Signal propagation in mobile communications. Principles of mobile communications. Evolution of the standards of mobile communication systems. Cellular approach. Signal propagation in mobile communications. GSM, GPRS and UMTS systems. Packet data transfer. HSPA and HSPA + systems. LTE and LTE Advanced system. 5G mobile systems. Quality of services tests in mobile networks (benchmarking). Mobile communications applications in IoT systems. Mobile systems applications in industry and system control. Applications of mobile communications in systems of connected vehicles. Mobile communications in medical applications (mHealth).			
Practical teaching (exercises, OFE, study and research work)	Solving practical problems in the field of mobile communication systems. Introduction to practical methods for testing the quality of services of mobile networks. Case studies – applications of mobile communications in IoT systems, systems of connected vehicels, health systems, industry, etc. Introduction to mobile applications development.			
Textbooks/references				
1	D.P.Agrawal, Q.A.Zeng, Introduction to Wireless and Mobile Systems, Thomson, 2006			
2	J. Rodriguez, “Fundamentals of 5G Mobile Networks”, Wiley, ISBN: 978-1-118-86752, 2015			
3	International (ETSI) Standards for Quality of Service Testing in Mobile Networks			
4	Selected book chapters and articles on the most recent applications of mobile communication systems			
5	Z. Marinkovič, B. Stošić, "Mobile Communication Systems", Power Point Slides, Faculty of Electronic Engineering, 2025.			
Number of classes of active education per week during semester/trimester/year				
Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	2	1	0	0
Teaching methods	Lectures, exercises, practical exercises, consultations			
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				
Projects	50			

Specification for the book of courses

Study program	Control Systems / Automatic Control		
Type and level of studies	Master Academic Studies		
The name of the course	Testing in the automotive industry		
Lecturer (for lectures)	Živanović B. Dragan		
Lecturer/associate (for exercises)			
Lecturer/associate (for OFE)	Miljković S. Goran		
Number of ECTS	5	**Course status (obligatory/elective)**	Elective
Prerequisites	None		
Course objectives	The aim of the course is for students to get theoretical and practical knowledge of the testing and measurement process in the automotive industry.		
Course outcomes	Students get knowledge about procedures, instruments, and software used for testing and measurement in the automotive industry. They are trained to test various types of communication interfaces and sensors used in cars.		
Course outline			
Theoretical teaching	Introduction to various testing and measurement techniques in the automotive industry. Electronic device design cycle. EMC device certification. Testing of analog, digital and mixed signal circuits. PCB testing. Using TestStand and LabVIEW software. Communication interfaces used in the automotive industry. Testing CAN and LIN communication. Automation of the testing process of various types of sensors used in cars.		
Practical teaching (exercises, OFE, study and research work)	Implementation of various test procedures using TestStand and LabVIEW software. Use of modern digital multimeters and oscilloscopes in the testing process. Observation of normal and distorted CAN and LIN communication signals. Cable testing. Automation of testing of position, vibration, temperature, speed, gas and level sensors, using virtual instrumentation.		
Textbooks/references			
1	Mandy Concepcion, Automotive Sensor Testing and Waveform Analysis, Mandy Concepcion, ISBN-13: 979-8227466150, 2022.		
2	Nicolas Navet, Automotive Embedded Systems Handbook, CRC Press, ISBN-10 : 084938026X, 2008.		
3	Tom Bonell, Automotive diagnostics: Electrical circuits, Techniques, diagrams, electrical components and detailed explanations, Independently published, ISBN-13: 979-8398024449, 2023.		
4	J. G. Webster, "Measurement, Instrumentation and Sensors Handbook", CRC Press, 2014.		
5			

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

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

Teaching methods	Lectures and laboratory exercises, preparation of seminar papers and project assignments, 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			
Projects	25		

Specification for the book of courses

Study program	Control Systems / Automatic Control Control Systems / Computer Control Systems and Measurement Techniques		
Type and level of studies	Master Academic 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)**	Obligatory / Elective	

Prerequisites	None
Course objectives	To enable students to understand the architecture, operation, and development of embedded systems, as well as to independently create and run simple Linux-based systems on embedded platforms such as the BeagleBone Black.
Course outcomes	Upon successful completion of this course, the student will be able to: a) explain the architecture and components of embedded systems, b) select and apply appropriate development tools and compilers (toolchains) for cross-compiling programs intended for embedded environments, c) understand and configure the system boot process, d) customize and compile the Linux kernel for an embedded platform, e) install and use a Linux SDK and libraries for embedded application development, f) create and test a simple kernel driver.
Course outline	
Theoretical teaching	Introduction to embedded systems: hardware components, software. Architecture: CPU, memory, peripherals, I/O interfaces. BeagleBone Black platform: AM335x SoC (ARM Cortex-A8 processor). Operating systems: types, selection criteria. Programming tools and toolchain: cross-compilation, GCC, binutils, make. Boot process: U-Boot bootloader. Linux Kernel: source tree structure, configuration, compilation. Device Tree: structure, compilation. File system: directories, minimal rootfs. Build systems: OpenEmbedded, Yocto, Buildroot. Flash memory and storage: eMMC, NAND/NOR Flash, file systems. Scripts: bootable SD cards. Linux SDK and libraries: OpenEmbedded SDK, glibc, uClibc. Linux device drivers: device classes and modules, user-space drivers, writing kernel-space drivers.
Practical teaching (exercises, OFE, study and research work)	1) Working in the Linux environment – basic commands, file system structures; 2) Introduction to the BeagleBone Black development board, connection and setup; 3) Installation of the development environment, toolchain, cross-compilation; 4) Writing and using Makefile scripts, project organization; 5) Serial communication and system preparation – working via UART; 6) Preparing the SD card for booting Linux on the embedded system; 7) U-Boot source code – U-Boot configuration; 8) Linux kernel source code – configuration and compilation; 9) Setting boot parameters, hardware description (Device Tree); 10) Creating the rootfs; integrating the rootfs, kernel, and DTB into the SD image; 11) Running Embedded Linux on the BeagleBone Black; 12) Using the Linux SDK (OpenEmbedded SDK); 13) Creating and loading a simple Linux Kernel module; 14) Development of a simple character device driver.
Textbooks/references	
1	Frank Vasquez, Chris Simmonds, Mastering Embedded Linux Programming, Packt Publishing, 2021.
2	Derek Molloy, Exploring BeagleBone: Tools and Techniques for Building with Embedded Linux, Wiley, 2019.
3	Changyi Gu, Building Embedded Systems, Programmable Hardware, Apress, 2016.
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	0	0

Teaching methods	Lectures; classroom exercises; laboratory exercises; homework assignments; project work; consultations

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points

Activity during lectures	5	**Written exam**	25
Exercises	25	**Oral exam**	25
Colloquia	20		
Projects			

Specification for the book of courses

<table>
<tr><td colspan="3">Study program</td><td colspan="3">Computer Science and Informatics / Computer Systems Security
Computer Science and Informatics / Data Engineering
Computer Science and Informatics / Information Systems and Technologies
Computer Science and Informatics / Software Engineering
Control Systems / Automatic Control</td></tr>
<tr><td colspan="3">Type and level of studies</td><td colspan="3">Master Academic Studies</td></tr>
<tr><td colspan="3">The name of the course</td><td colspan="3">Virtual and Augmented Reality Systems</td></tr>
<tr><td colspan="3">Lecturer (for lectures)</td><td colspan="3">Milosavljević Lj. Aleksandar, Dimitrijević M. Aleksandar</td></tr>
<tr><td colspan="3">Lecturer/associate (for exercises)</td><td colspan="3">Dimitrijević M. Aleksandar</td></tr>
<tr><td colspan="3">Lecturer/associate (for OFE)</td><td colspan="3"></td></tr>
<tr><td colspan="2">Number of ECTS</td><td>6</td><td colspan="2">Course status (obligatory/elective)</td><td>Obligatory / Elective</td></tr>
<tr><td>Prerequisites</td><td colspan="5">None</td></tr>
<tr><td>Course objectives</td><td colspan="5">Introducing students to the field of virtual and augmented reality and introducing them to the basic devices, algorithms, and techniques used in the implementation of these systems.</td></tr>
<tr><td>Course outcomes</td><td colspan="5">Knowledge of the basic principles, devices, techniques and algorithms used in the implementation of virtual and augmented reality systems.</td></tr>
<tr><td colspan="6">Course outline</td></tr>
<tr><td>Theoretical teaching</td><td colspan="5">Introduction to the fields of virtual and augmented reality and historical development. Architecture of virtual reality systems. Input and output devices for virtual reality. Gestural and haptic interface. Geometric modeling of virtual objects. Kinematic and physical modeling. Virtual worlds. Positioning of augmented reality in the continuum between the real world and virtual reality. Classification of augmented reality systems. Techniques for determining the observer's view in augmented reality systems. Augmented virtual environments. Areas and examples of application of virtual and augmented reality systems.</td></tr>
<tr><td>Practical teaching (exercises, OFE, study and research work)</td><td colspan="5">Practical work includes programming virtual and augmented reality elements in the Unity environment, using the Google Cardboard, Vuforia and AR Foundation libraries. Working with Google Cardboard, students develop simple virtual reality applications for mobile devices, Vuforia is used for augmented reality applications based on image recognition, while AR Foundation enables the creation of more advanced solutions in the field of augmented reality based on surface recognition and interaction with the environment in real time.</td></tr>
<tr><td colspan="6">Textbooks/references</td></tr>
<tr><td>1</td><td colspan="5">G. C. Burdea, P. Coiffet, Virtual Reality Technology , 3rd Edition, Wiley-IEEE Press, 2024.</td></tr>
<tr><td>2</td><td colspan="5">W. R. Sherman, A. B. Craig, Understanding Virtual Reality: Interface, Application, and Design , 2nd Edition, Morgan Kaufmann, 2018.</td></tr>
<tr><td>3</td><td colspan="5">D. Schmalstieg, T. Höllerer, Augmented Reality: Principles and Practice , Addison-Wesley Professional, 2016.</td></tr>
<tr><td>4</td><td colspan="5">A. Braun, R. Rizzo, XR Development with Unity , Packt Publishing, 2023.</td></tr>
<tr><td>5</td><td colspan="5">J. Linowes, Augmented Reality with Unity AR Foundation , Packt Publishing, 2021.</td></tr>
<tr><td colspan="6">Number of classes of active education per week during semester/trimester/year</td></tr>
<tr><td>Lectures</td><td>Exercises</td><td>OFE</td><td colspan="2">Study and research work</td><td>Other classes</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td colspan="2">0</td><td>0</td></tr>
<tr><td>Teaching methods</td><td colspan="5">Lectures, auditory exercises, laboratory exercises, independent work of students on projects.</td></tr>
<tr><td colspan="6">Grade (maximum number of points 100)</td></tr>
<tr><td colspan="2">Pre-exam duties</td><td>Points</td><td colspan="2">Final exam</td><td>Points</td></tr>
<tr><td colspan="2">Activity during lectures</td><td></td><td colspan="2">Written exam</td><td></td></tr>
<tr><td colspan="2">Exercises</td><td>30</td><td colspan="2">Oral exam</td><td>40</td></tr>
<tr><td colspan="2">Colloquia</td><td></td><td colspan="2"></td><td></td></tr>
<tr><td colspan="2">Projects</td><td>30</td><td colspan="2"></td><td></td></tr>
</table>

Specification for the book of courses

Study program	Control Systems		
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	6	**Course status (obligatory/elective)**	Obligatory

Prerequisites	
Course objectives	Application of fundamental, theoretical-methodological, scientific-professional, and professional-applicative knowledge and methods to solving specific problems. The student analyzes the problem, its structure, and complexity, and based on the conducted analyses, draws conclusions about possible solutions. By studying the literature, the student becomes familiar with methods intended for solving similar tasks and with engineering practices in addressing them.
Course outcomes	Enabling students to independently apply previously acquired knowledge from various fields they have studied, in order to understand the structure of a given problem and to perform a systematic analysis aimed at drawing conclusions about possible directions for its resolution. Through independent use of literature, students expand their knowledge by studying different methods and papers related to similar problems. In this way, students develop the ability to conduct analyses and identify problems within the given area of study. Through the practical application of acquired knowledge, students develop the ability to recognize the role and position of engineers in their chosen field, the need for collaboration with other professions, and the importance of teamwork.
Course outline	
Theoretical teaching	It is individually structured in accordance with the requirements of the specific diploma or master's thesis, its complexity, and structure. Based on their interests and preferences, the student selects the area of study and the supervising professor from the list of faculty members in the study program, who defines the specific task. The student studies professional literature, technical and scientific papers dealing with similar topics, conducts analyses to find a solution to the specific task, or performs certain experiments in the laboratory. The study work also includes actively following primary research findings, organizing and conducting experiments, numerical simulations and statistical data processing, and writing a seminar paper within the narrower scientific-teaching field related to the topic of the independent research work.
Practical teaching (exercises, OFE, study and research work)	
Textbooks/references	
1	University of Niš, Faculty of Electronic Engineering, Guidelines and Template for the Preparation of Final, Diploma and Master's Theses, Niš, available at: https://sip.elfak.ni.ac.rs/downloads/obrasci/forma-diplomski-rad.pdf
2	T. M. Young, Technical Writing A-Z: A Commonsense Guide to Engineering Reports and Theses, ASME Press, New York, 2005, ISBN 978-0-7918-0236-6.
3	E. J. Rothwell and M. J. Cloud, Engineering Writing by Design: Creating Formal Documents of Lasting Value, CRC Press, 2017, ISBN 9781482234329.
4	H. El Chaarani and Z. El Abiad, How to Write a Master Thesis: The Easy Handbook Guide, New Edition, Journal of Contemporary Research in Business Administration and Economic Sciences, 2021.
5	

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

Lectures	Exercises	OFE	Study and research work	Other classes
			12	

Teaching methods	Mentoring and individual consultations.		
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	
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	14	**Course status (obligatory/elective)**	Obligatory

Prerequisites	
Course objectives	The purpose of the Master thesis is to integrate, validate, and apply the knowledge acquired during Master academic studies. The student is given the opportunity to demonstrate the ability to independently carry out a project, which may be of a practical, research, or theoretical-methodological nature. The student also gains experience in presenting their work in written form and through an oral presentation during the thesis defense.
Course outcomes	Ability to lead an independent project, formulate and analyze problems, critically evaluate possible solutions, and review literature in the given field. Application of acquired engineering and design knowledge and skills to problem-solving, taking into account the complexity, cost, reliability, and efficiency of the solution. Ability to write the thesis in the prescribed format. Ability to clearly present and explain the completed project through an oral defense.
Course outline	
Theoretical teaching	The Master thesis is an independent research, practical, or theoretical-methodological work by the student, aligned with the level of study, through which the student explores a specific area by reviewing literature and adopting the research or design methodology necessary for completing the thesis. In the course of writing the thesis, the student applies both practical and theoretical knowledge acquired during the studies. The written thesis typically includes an introductory chapter, problem definition, overview of the field and existing solutions, proposed and described solution, conclusion, and references. A public oral defense of the thesis is organized before a committee of three members, one of whom is the thesis mentor. During the oral defense, the candidate presents the results of its work and answers the questions posed by the committee members, thereby demonstrating the ability to orally present its project.
Practical teaching (exercises, OFE, study and research work)	
Textbooks/references	
1	University of Niš, Faculty of Electronic Engineering, Guidelines and Template for the Preparation of Final, Diploma and Master's Theses, Niš, available at: https://sip.elfak.ni.ac.rs/downloads/obrasci/forma-diplomski-rad.pdf
2	T. M. Young, Technical Writing A-Z: A Commonsense Guide to Engineering Reports and Theses, ASME Press, New York, 2005, ISBN 978-0-7918-0236-6.
3	E. J. Rothwell and M. J. Cloud, Engineering Writing by Design: Creating Formal Documents of Lasting Value, CRC Press, 2017, ISBN 9781482234329.
4	H. El Chaarani and Z. El Abiad, How to Write a Master Thesis: The Easy Handbook Guide, New Edition, Journal of Contemporary Research in Business Administration and Economic Sciences, 2021.
5	

Number of classes of active education per week during semester/trimester/year				
Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
				2

Teaching methods	Mentoring and individual consultations.

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			

Specification for the book of courses

Study program	Control Systems / Computer Control Systems and Measurement Techniques		
Type and level of studies	Master Academic 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	None
Course objectives	The aim of the course is to provide the student with a more detailed introduction to the hardware and software of measurement control and acquisition measurement systems, to examine all techniques for connecting individual components into a complex system, and to examine the impact of the applied techniques on measurement accuracy.
Course outcomes	The student will be able to recognize when it is necessary to use virtual instruments, a centralized or distributed measurement system, which specific components should be used, and to recognize potential problems that arise in practice.
Course outline	
Theoretical teaching	Connecting sensors, measuring transducers and actuators. Hardware structure of computer measurement systems. Standard interface systems. Distributed measurement systems. Components of distributed systems. Intelligent measuring transducers. Hardware and software techniques for compensation of measurement results. Electrical insulation in measurement systems. Industrial network protocols. Virtual instrumentation and virtual laboratories. Examples of practical implementations. Real-time operation. Software design. Calibration of computer measuring devices and systems. Automatic test systems.
Practical teaching (exercises, OFE, study and research work)	Implementation of specific examples using LabVIEW software, acquisition cards and sensors. Introduction to interpolation, signal filtering and using property nodes in the LabVIEW environment. Working with local and global variables, Event structure, tables in the LabVIEW environment. Measuring and logging temperature with an NTC sensor using an acquisition card. Continuous acquisition of measurement signals. Generating signals and counting events using an acquisition card. Independent project development in the LabVIEW environment
Textbooks/references	
1	Cotfas, P. A., Cotfas, D. T., Hedesiu, H. (Eds.), LabVIEW – Virtual Instrumentation in Education and Industry, IntechOpen, London, 2024.
2	R. Johnson, „LabVIEW Programming for Engineering Applications: Definitive Reference for Developers and Engineers”, HiTeX Press, 2025.
3	G. Roberts, F. Taenzler, M. Burns, "An Introduction to Mixed-Signal IC Test and Measurement", Oxford Univ. Press,New York, 2012.
4	Ronald W. Larsen, “LabVIEW for Engineers”, Prentice Hall, 2011.
5	„Data acquisition handbook“, Measurement Computing Corporation, 2012.

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

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

Teaching methods	Lectures using modern presentation tools, computational exercises, laboratory exercises, discussion of student solutions to assigned tasks, preparation of project tasks, 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			
Projects	25		

Specification for the book of courses

Study program	Control Systems / Computer Control Systems and Measurement Techniques		
Type and level of studies	Master Academic Studies		
The name of the course	Design of Microcomputer Measurement Instruments		
Lecturer (for lectures)	Živanović B. Dragan, Jovanović R. Jelena		
Lecturer/associate (for exercises)	Ranđelović S. Ivana		
Lecturer/associate (for OFE)	Đorđević-Kozarov R. Jelena		
Number of ECTS 5	**Course status (obligatory/elective)**	Elective	
Prerequisites	None		
Course objectives	The objective of the course is for students to acquire theoretical and practical knowledge about the operating principles, architecture and application of microcontrollers and microprocessors in modern measuring instruments. Special emphasis is placed on intelligent sensors, components of microcontroller systems, digital signal processing, communication protocols and methods for the design and calibration of measurement systems.		
Course outcomes	Upon completion of the course, the student will be able to understand the basic concepts of microprocessors, microcontrollers and their applications in measuring instruments; analyze and differentiate the components of microcontroller systems (CPU, memory, timers, ports, etc.); design and implement simple microcontroller-based measurement systems; use communication protocols for connecting sensors and actuators; develop and test real-time software for measurement and control; conduct basic methods of calibration, testing and diagnostics of measurement instruments; and apply the acquired knowledge in creating a mini-project in the field of microcontroller-based measurement systems.		
Course outline			
Theoretical teaching	Introduction to microprocessors and microcontrollers; Types of microprocessor-based measurement instruments: smart sensors, digital panel meters, PLC, stand-alone devices; Microcontroller architecture: CPU, memories, timers, I/O ports, oscillators, communication interfaces; Serial communication and protocols: RS-232, RS-485, I2C, SPI, MODBUS; Real-time software: RTOS, I/O device programming, interrupts; Development tools: IDE environments, Keil µVision, C51 compiler, debugging; Measurement chain: A/D conversion, linearity, self-testing, signal processing; Sensor and actuator connections; Power supply, safety, interference protection, electrical isolation; Design process: modeling, analysis, design, testing, documentation; Testing and calibration: methods, measurement stability, practical examples.		
Practical teaching (exercises, OFE, study and research work)	Exercises: Programming microcontrollers (e.g., 8051, Arduino) for basic measurement functions; Configuration of serial communication and data exchange with sensors; Measurement of temperature and voltage using A/D converters; Implementation of PID regulation using a microcontroller; Use of IDEs (e.g., Keil, Arduino IDE) for software development and testing; Sensor calibration exercises and measurement error analysis. Other forms of teaching: Analysis of real examples of measurement instruments in industry; Discussion on safety and EMC requirements for measurement systems; Group work on solving tasks on designing and connecting sensors and actuators. Study and research work (as needed): Mini-project: designing a measurement system with a microcontroller; Implementation of a simple RTOS environment; Display and analysis of real-time measurement results with sensors (e.g., ADXL accelerometer).		
Textbooks/references			
1	Jonathan W. Valvano, "Embedded Microcomputer Systems: Real Time Interfacing", 3rd Edition, 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	Richard Zurawski, "Embedded Systems Handbook", 1st Edition, CRC Press, 2005.		
4	Volker Ziemann, "A Hands-On Course in Sensors Using the Arduino and Raspberry Pi", CRC Press, Taylor & Francis Group, 2018.		
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	0	0

<table>
<tr><td>Teaching methods</td><td colspan="3">Lectures using modern presentation tools, computational and laboratory exercises, preparation of practical and project tasks, discussions and consultations.</td></tr>
<tr><td colspan="4">Grade (maximum number of points 100)</td></tr>
<tr><td>Pre-exam duties</td><td>Points</td><td>Final exam</td><td>Points</td></tr>
<tr><td>Activity during lectures</td><td>10</td><td>Written exam</td><td>20</td></tr>
<tr><td>Exercises</td><td>20</td><td>Oral exam</td><td>20</td></tr>
<tr><td>Colloquia</td><td>0</td><td></td><td></td></tr>
<tr><td>Projects</td><td>30</td><td></td><td></td></tr>
<tr><td colspan="4"></td></tr>
</table>

Specification for the book of courses

Study program		Control Systems / Computer Control Systems and Measurement Techniques	
Type and level of studies		Master Academic Studies	
The name of the course		Electromedical Instrumentation	
Lecturer (for lectures)		Dinčić R. Milan, Simić M. Milan	
Lecturer/associate (for exercises)		Đorđević-Kozarov R. Jelena	
Lecturer/associate (for OFE)		Jocić V. Aleksandar	
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	None
Course objectives	The course aims to provide students with the knowledge and skills required to understand the structure, operating principles, and characteristics of modern electromedical instrumentation, as well as methods for the measurement, acquisition, conditioning, digitization, and processing of biomedical signals. Students acquire knowledge of the operating principles of diagnostic and therapeutic medical devices, their measurement and communication components, and the criteria for the selection, safe use, and evaluation of electromedical equipment in clinical practice.
Course outcomes	Upon successful completion of the course, the student is able to explain the structure and operating principles of electromedical measurement systems; analyze the operation of sensors and transducers, signal conditioning, digitization, and signal processing systems; evaluate the characteristics and applications of diagnostic and therapeutic medical devices; analyze the principles of medical image formation and contemporary medical imaging techniques; apply the fundamental principles of medical device safety and relevant standards; and select, analyze, and evaluate appropriate electromedical instrumentation for specific medical applications.
Course outline	
Theoretical teaching	Structure and characteristics of biomedical measurement systems. Measurands, sensors and transducers, signal conditioning, digitization and processing, computer and communication technologies, and measuring instruments in biomedical measurement systems. Measurement of electrophysiological signals. Medical imaging techniques: X-ray imaging, computed tomography (CT), positron emission tomography (PET), magnetic resonance imaging (MRI), gamma radiation in medicine, ultrasound imaging, thermography, and infrared spectroscopy. Medical laser applications. Defibrillators and pacemakers. Mechanical ventilation. Anesthesia equipment, electrical stimulation, and electrotherapy devices. Fundamentals of medical electrical equipment safety standards (IEC 60601) and medical device risk management.
Practical teaching (exercises, OFE, study and research work)	Practical training includes laboratory and classroom exercises in electromedical instrumentation, measurement and analysis of biomedical signals, familiarization with the operating principles of diagnostic and therapeutic medical devices, as well as demonstration sessions in healthcare institutions, subject to the availability of appropriate technical and organizational conditions. Students complete seminar papers and project assignments involving the analysis, design, and evaluation of electromedical measurement systems and medical instrumentation.
Textbooks/references	
1	Webster, J. G., Nimunkar, A. J. (Eds.), Medical Instrumentation: Application and Design, 5th ed., Wiley, Hoboken, NJ, USA, 2020.
2	Bronzino, J. D., Peterson, D. R. (Eds.), The Biomedical Engineering Handbook, 5th ed., CRC Press, Boca Raton, FL, USA, 2022.
3	Khandpur, R. S., Handbook of Biomedical Instrumentation, 4th ed., McGraw Hill Education, New Delhi, India, 2021.
4	Enderle, J. D., Bronzino, J. D., Introduction to Biomedical Engineering, 4th ed., Academic Press, Elsevier, Cambridge, MA, USA, 2021.
5	Carr, J. J., Brown, J. M., Introduction to Biomedical Equipment Technology, 5th ed., Pearson, Boston, MA, USA, 2018.

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

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

Teaching methods	Teaching is carried out through lectures supported by multimedia presentations and demonstrations, laboratory and classroom exercises, analysis and discussion of scientific papers and case studies, demonstrations of modern electromedical equipment, and the independent preparation and presentation of seminar papers and project assignments.		
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 / Computer Control Systems and Measurement Techniques		
Type and level of studies	Master Academic Studies		
The name of the course	IoT Sensors and Measurement Systems		
Lecturer (for lectures)	Jovanović R. Jelena		
Lecturer/associate (for exercises)	Ranđelović S. Ivana		
Lecturer/associate (for OFE)	Jovanović R. Jelena		
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	None
Course objectives	Understanding the operating principles of IoT (Internet of Things) sensors and their application in real-time measurement systems. Acquiring knowledge in the field of designing and implementing measurement systems for use in various smart environments. Introducing students to the use of IoT sensors, communication technologies and data analysis techniques for real-time decision-making.
Course outcomes	Upon completion of the course, students will possess knowledge of: analog and digital IoT sensors; types of measurement data transmission; open-source Arduino and Raspberry Pi platforms; sensors used in smart environment applications; selection and implementation of data transmission methods based on end-user requirements; programming in the C language for working with Arduino and Raspberry Pi platforms; design and development of complete real-time data acquisition systems based on Arduino and Raspberry Pi platforms; and data storage and visualization using cloud services.
Course outline	
Theoretical teaching	Analog sensors; Digital sensors; Types of data transmission, advantages and disadvantages; Arduino microcontroller boards and interfacing with sensors and additional electronics (shields); Types of communication interfaces between Arduino microcontrollers and sensors; Raspberry Pi microcomputers and their application in implementing real-time data acquisition systems; Raspberry Pi hardware; Raspberry Pi software; Connecting peripherals to the Raspberry Pi microcomputer; C programming on the Raspberry Pi microcomputer; General Purpose Input/Outputs – GPIO; Real-time measurement data acquisition using Raspberry Pi microcomputers and Arduino microcontrollers; Raspberry Pi microcomputer as an IoT sensor and web server.
Practical teaching (exercises, OFE, study and research work)	Writing programs in the C programming language for the purpose of data acquisition using Arduino and Raspberry Pi platforms; Familiarization with and connection of the basic hardware of a measurement system for real-time data acquisition; Display of data collected in real-time and its storage on cloud services; Implementation of project tasks; Practical teaching is demonstration-based.
Textbooks/references	
1	V. Ziemann, "A Hands-On Course in Sensors Using the Arduino and Raspberry Pi", CRC Press, Boca Raton, USA, 2018.
2	B. Nayak, M. Mangla, S. N. Mohanty, S. Satpathy, "Integration of Cloud Computing with Internet of Things: Foundations, Analytics and Applications", Wiley, 2021
3	D. Molloy, "Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux", Wiley, New York, USA, 2016.
4	V. K. Khanna, "IoT Sensors: An Exploration of Sensors for Internet of Things", Boca Raton, USA, CRC Press, 2025.
5	R. Singh, A. Gehlot, L. R. Gupta, B. Singh, M. Swain, "Internet of Things with Raspberry Pi and Arduino", United States: CRC Press, 2019.

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

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

Teaching methods	Lectures; Computational exercises; Laboratory exercises; Consultations; Project task implementation.

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points
Activity during lectures	5	Written exam	20

Exercises	15	**Oral exam**	10
Colloquia	40		
Projects	10		

Specification for the book of courses

Study program	Control Systems / Automatic Control Control Systems / Computer Control Systems and Measurement Techniques			
Type and level of studies	Master Academic Studies			
The name of the course	Digital Image Processing			
Lecturer (for lectures)	Nikolić V. Saša, Cvetković S. Stevica			
Lecturer/associate (for exercises)	Cvetković S. Stevica			
Lecturer/associate (for OFE)	Cvetković S. Stevica			
Number of ECTS	5	**Course status (obligatory/elective)**	Obligatory / Elective	
Prerequisites	None			
Course objectives	Present basic algorithms for digital image processing: quality improvement, sharpening, filtering, segmentation, etc. Master the mathematical apparatus for applying operations in digital image processing. Implement the acquired knowledge in software in Matlab.			
Course outcomes	To enable students to understand and independently implement basic digital image processing operations in Matlab or Python.			
Course outline				
Theoretical teaching	Components of an image processing system. Photometry, image acquisition and digitization. Image enhancement in the spatial domain. Image histogram. Linear filtering in the spatial domain - image sharpening. Fast image filtering in the frequency domain - convolution theorem. Nonlinear image filtering - an example of a median filter. Image restoration in the presence of noise. Image segmentation - comparison with a threshold. Morphological operations on an image. Color image processing.			
Practical teaching (exercises, OFE, study and research work)	Computer exercises in the Matlab and Python software packages. Practical program implementation of digital image processing algorithms presented in lectures. Working with matrices, scripts, functions and flow control. Loading and displaying images, pixel analysis and data types. Techniques for improving image quality are covered - contrast, gamma correction and histogram. Spatial and frequency filtering, as well as edge detection methods. Segmentation, morphological operations, and color image processing are also covered. The goal is to master the most important image processing algorithms in Matlab and Python.			
Textbooks/references				
1	Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, 3rd edition, Prentice-Hall, 2008.			
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**
2	1	1	0	0
Teaching methods	Lectures, auditory exercises, laboratory exercises			
Grade (maximum number of points 100)				
Pre-exam duties	**Points**	**Final exam**	**Points**	
Activity during lectures	5	**Written exam**		
Exercises	5	**Oral exam**	40	
Colloquia	50			
Projects				

Specification for the book of courses

Study program	Control Systems / Computer Control Systems and Measurement Techniques Electron Devices and Microsystems		
Type and level of studies	Master Academic Studies		
The name of the course	Medical Physics		
Lecturer (for lectures)	Ristić S. Goran		
Lecturer/associate (for exercises)	Živanović N. Emilija		
Lecturer/associate (for OFE)			
Number of ECTS	5	**Course status (obligatory/elective)**	Obligatory / Elective

Prerequisites	None
Course objectives	Introduction to application of the ionizing and non-ionizing radiation in medicine, as well as the principle of basic methods of medical diagnostics.
Course outcomes	Knowledge of diagnostic and therapeutic methods in medicine that are based on the ionizing and non-ionizing radiation, and the equipment is used in that purpose.
Course outline	
Theoretical teaching	Medical diagnostics. X-rays and X-ray characteristics and their application in medicine. Radiography and fluoroscopy, mammography, X-ray, computer tomography. Digital Flat Panel X-ray Appliances. The production and the characteristics of ultrasound and its application in medicine. Principle of magnetic resonance, and its application in medical diagnostics. Use of radioisotopes in medical diagnostics and radiotherapy. PET diagnostics. Electrocardiography, Laser application in medicine. Application of radiofrequency and optical radiation in medical diagnostics and therapy. Radiotherapy devices.
Practical teaching (exercises, OFE, study and research work)	Practical classes take place through computational exercises. Concrete problems are solved during computational tutorials in order to make students more easily and successfully master certain areas that are covered in theoretical classes.
Textbooks/references	
1	E. Samei, D.J. Peck, Hendee's Physics of Medical Imaging, Wiley-Blackwell, ISBN: 978-1-118-67096-5, 2019
2	S.A. Kane, B.A. Gelman, Introduction to Physics in Modern Medicine (3rd Edition), CRC Press (Taylor & Francis Group), ISBN: 978-1138036031, 2020
3	J. Enderle, J. Bronzino, S. Blanchard, Introduction to Biomedical Engineering (4th Edition), Academic Press (Elsevier), ISBN: 978-0128224380, 2021
4	S.Keevil, R. Padovani, S. Tabakov, T. Greener, C. Lewis, Introduction to Medical Physics, CRC Press (Taylor & Francis Group), ISBN: 978-1138742833, 2022
5	G. Ristić, Medical Physics, Lecture Notes, Faculty of Electronic Engineering, Niš, 2021

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

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

Teaching methods	Lectures, computational exercises and 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	20		
Projects	20		

Specification for the book of courses

Study program	Control Systems / Automatic Control Control Systems / Computer Control Systems and Measurement Techniques		
Type and level of studies	Master Academic Studies		
The name of the course	Computer Control Systems		
Lecturer (for lectures)	Jovanović D. Zoran, Spasić D. Miodrag		
Lecturer/associate (for exercises)	Spasić D. Miodrag, Perić Lj. Staniša		
Lecturer/associate (for OFE)	Sibinović D. Vladimir, Mitić M. Vladimir		
Number of ECTS	6	**Course status (obligatory/elective)**	Obligatory / Elective

Prerequisites	None
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 work)	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	A. Veloni, N. Miridakis, "Digital Control Systems: Theoretical Problems and Simulation Tools" CRC Press, 2017.

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

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

Teaching methods	Lectures, classroom exercises, computer exercises

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 / Automatic Control Control Systems / Computer Control Systems and Measurement Techniques		
Type and level of studies	Master Academic Studies		
The name of the course	Reinforcement Learning in Control Systems		
Lecturer (for lectures)	Milojković T. Marko, Milovanović B. Miroslav		
Lecturer/associate (for exercises)	Milojković T. Marko, Milovanović B. Miroslav		
Lecturer/associate (for OFE)	Perić Lj. Staniša, Milovanović B. Miroslav, Spasić D. Miodrag		
Number of ECTS	6	**Course status (obligatory/elective)**	Obligatory / Elective

Prerequisites	
Course objectives	The aim of the course is for students to acquire basic theoretical and practical knowledge in the field of reinforcement learning and its applications in systems control, with a special focus on simulation environments and autonomous systems. Through the real-world examples and implementation of reinforcement learning algorithms, students will learn how agents are trained through reward and punishment, how appropriate algorithms are selected, and how they are applied in modern applications.
Course outcomes	Upon completion of the course, the student will gain an understanding of the basic concepts of reinforcement learning and its applications in modern control systems. They will be able to formulate simple control problems in a form suitable for the application of reinforcement learning algorithms, as well as to apply basic methods for training agents in simulated environments. They will understand the role of reward, state, action and policy in the decision-making process. The student will be able to implement and test simple models in the Python programming language, using custom libraries and simulation tools. In addition, they will be able to interpret the obtained results, evaluate the performance of agents and propose improvements. They will apply the acquired knowledge in solving practical tasks in the field of intelligent control, such as control in industrial environments and simulation of the behavior of autonomous systems.
Course outline	
Theoretical teaching	Introduction to reinforcement learning and its applications in control systems. Markov decision processes (MDP) and optimization fundamentals. Q-learning algorithm. Deep Q-Networks (DQN) – value approximation using neural networks. Policy Gradient methods. Actor-Critic methods and the advantages of a combined approach. Exploitation and exploration in the context of control. Generalization, stability and overfitting in reinforcement learning. Applications of reinforcement learning in engineering problems. Introduction to simulation frameworks and OpenAI Gym. Basics of working with the CARLA simulator and its applications. Application of reinforcement learning in autonomous vehicle control simulation.
Practical teaching (exercises, OFE, study and research work)	Practical teaching is implemented through laboratory exercises in the Python programming language, using tools such as Google Colab, OpenAI Gym and CARLA simulator. Students will implement basic reinforcement learning algorithms through specific tasks, test them in simulated environments and analyze the results. The goal is to develop intuition, understand the functioning of agents and apply theoretical knowledge in solving practical management problems.
Textbooks/references	
1	Richard S. Sutton, Andrew G. Barto – Reinforcement Learning: An Introduction, Second Edition, MIT Press, 2018.
2	Laura Graesser, Wah Loon Keng – Foundations of Deep Reinforcement Learning: Theory and Practice in Python, Addison-Wesley, 2019.
3	Maxim Lapan – Deep Reinforcement Learning Hands-On, Second Edition, Packt Publishing, 2020.
4	Csaba Szepesvári – Algorithms for Reinforcement Learning, Morgan & Claypool Publishers, 2010.
5	Lucian Busoniu, Robert Babuska, Bart De Schutter – Reinforcement Learning and Dynamic Programming Using Function Approximators, CRC Press, 2010.

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

2	2	1	0	0
Teaching methods	Teaching is conducted through lectures and interactive exercises, with demonstrations and work on specific tasks in the Python programming environment. Students actively participate in problem solving, simulations, and implementation of reinforcement learning algorithms.			
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	Control Systems / Automatic Control Control Systems / Computer Control Systems and Measurement Techniques
Type and level of studies	Master Academic Studies
The name of the course	Electrical Drive Control
Lecturer (for lectures)	Antić S. Dragan, Mitić B. Darko, Nikolić S. Saša
Lecturer/associate (for exercises)	Mitić B. Darko, Nikolić S. Saša, Danković B. Nikola
Lecturer/associate (for OFE)	

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

Prerequisites	None
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	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 (ED) coordinates. System: controlled power converter – ED. Typical structures of ED control. Methods for design of ED 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. Design of state feedback control.
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	I. Boldea, S.A. Nasar, *Vector Control of AC Drives* , CRC Press, 1992.
2	W. Leonhard, *Control of Electrical Drives* , Springer-Verlag, 1996.
3	Adel Merabet (Ed.), *Advanced Control Systems for Electric Drives* , MDPI, 2020.
4	Tian-Hua Liu (Ed.), *Design and Control of Electrical Motor Drives* , MDPI, 2021.
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	0	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		Oral exam	30
Colloquia	40		
Projects			

Specification for the book of courses

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

Prerequisites	
Course objectives	Familiarization with the work process in the company where the professional internship is conducted, its objectives, and organizational units. Getting to know the team and the project to which the student is assigned within their internship, selected in accordance with the elective study area (module) chosen by the student. Understanding the company's work processes, business operations, awareness of work-related risks, and participation in design, documentation development, or quality control, in accordance with the workflow and the possibilities of the working environment.
Course outcomes	Enhancing the student's ability to join the workforce upon completion of studies. Developing a sense of responsibility, a professional approach to job, and team communication skills. Supplementing the theoretical knowledge acquired within the study program with practical insight into the issues covered by the student's field of study. Utilizing the experience of professionals employed in the institution where the internship is conducted to broaden practical knowledge and motivate students. Gaining a clear understanding of the applicability of the knowledge and skills acquired through the study program in real-world practice.
Course outline	
Theoretical teaching	
Practical teaching (exercises, OFE, study and research work)	The content of the professional internship is fully aligned with its objectives. The student becomes familiar with the company's structure and business goals, adapts their engagement to the chosen field of study, and duly fulfills work responsibilities in accordance with the duties of the company's employees. The student describes their own engagement during the internship and provides a critical reflection on their experience, as well as the knowledge and skills acquired during the internship.
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	The student generally independently selects a company from the public, private, or state sector in which to complete the professional internship. The internship may also be conducted abroad, in which case the student additionally improves their foreign language skills. Upon the student's proposal, the head of the elective field (module) approves the internship in the desired institution and, upon request, issues a written referral for the internship to the person responsible for supervising the internship at the given institution. Upon completion of the internship, based on the student's report and a confirmation issued by the responsible person—signed and stamped by the company—verifying that the internship was completed, the student is awarded 3 ECTS credits for the completed professional internship.

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

Prerequisites	None
Course objectives	Introducing students to modern sensor technologies—such as integrated Hall sensors and MEMS sensors—and sensor systems used for vibration signal measurement and analysis, as well as predictive maintenance in industry. The course also covers wireless sensor systems, technologies for wireless transmission of measurement data via mobile networks, and wireless sensor networks.
Course outcomes	Students will acquire theoretical and practical knowledge of modern sensor technologies and systems.
Course outline	
Theoretical teaching	Characteristics, fabrication technologies, operating principles, and applications of integrated Hall sensors and MEMS sensors. Sensor systems for vibration signal acquisition and analysis. Predictive maintenance in industry. Characteristics of wireless sensor systems. Communication technologies for wireless transmission of measurement data over mobile phone networks. Wireless sensor networks – definition, operating principles, and architecture; applications of wireless sensors and sensor networks in industry, military, construction, medicine, seismology, biology, and agricultural systems; protocols in wireless sensor networks.
Practical teaching (exercises, OFE, study and research work)	Tutorials, problem-solving exercises, laboratory exercises, preparation of project assignments and seminar papers, aimed at enabling students to acquire practical knowledge in the design and implementation of modern sensor systems.
Textbooks/references	
1	Edward Ramsden, "Hall-Effect Sensors, Second Edition: Theory and Application", Newnes, 2006.
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	Senchun Chai, Zhaoyang Wang, Baihai Zhang, Lingguo Cui, Runqi Chai, "Wireless Sensor Networks", Springer, 2020.
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	0	0

Teaching methods	Lectures, problem-solving exercises, discussions of student solutions to assigned project tasks, consultations, tutorials, and laboratory sessions.

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 / Computer Control Systems and Measurement Techniques	
Type and level of studies		Master Academic Studies	
The name of the course		Virtual instrumentation in biomedical measurements	
Lecturer (for lectures)		Živanović B. Dragan, Simić M. Milan	
Lecturer/associate (for exercises)		Đorđević-Kozarov R. Jelena	
Lecturer/associate (for OFE)		Miljković S. Goran	
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	None
Course objectives	Acquiring knowledge in the field of virtual measurement instrumentation in biomedicine. Introduction to the concept, hardware and programming techniques of virtual measurement instruments. Understanding the problems and techniques of acquisition and processing of biomedical measurement signals.
Course outcomes	Understanding the principles of operation and use of virtual measurement instrumentation in biomedicine. Ability to solve specific project tasks, select measurement system components and implement programs in the LabVIEW graphical programming language. Ability to search for relevant literature and other forms of information in the field of virtual measurement instrumentation in biomedicine and ability to present research results.
Course outline	
Theoretical teaching	Virtual instrument hardware. LabVIEW programming language, concepts and techniques. Front panel, block diagram, function palettes. Data flow and parallel execution of code sections. Signal analysis. Measurement error reduction in virtual instruments. Linearization, signal filtering, compensation of influencing variables, calibration. Advanced data display. Serial communication with separate instruments. Sensor and actuator connection. Sensors for medical instrumentation and sensor modules. Sensor interfaces. Medical signal processing modules. Medical information systems networks. Internet, mobile networks and distributed systems integration. Applications of virtual measurement instrumentation in biomedical measurements and monitoring. Applications of virtual measurement instrumentation in testing medical devices and systems.
Practical teaching (exercises, OFE, study and research work)	Laboratory exercises: Solving programming tasks in LabVIEW. Examples of concrete virtual measuring instrumentation in biomedicine. Development of projects in the field of signal acquisition and processing. Development of seminar papers in the field of biomedicine.
Textbooks/references	
1	Badnjević, A., Spahić, L., Bego, T., Deumić, S., Biomedical Instrumentation: Concepts, Technologies, and Future Innovations, Springer Nature, Cham, 2026.
2	Rangayyan, R. M., Krishnan, S., Biomedical Signal Analysis, John Wiley & Sons, Hoboken, 2024.
3	Cotfas, P. A., Cotfas, D. T., Hedesiu, H. (Eds.), LabVIEW – Virtual Instrumentation in Education and Industry, IntechOpen, London, 2024.
4	da Silva, H. P., Bota, P. J., do Carmo, A. S. C. (Eds.), Open Source Biomedical Engineering: Bridging the Gap Between Sensing, Processing, and Visualization, Springer Nature, Cham, 2026.
5	Badnjević, A., Spahić, L. (Eds.), Biosensors: Principles, Technologies, and Emerging Innovations, Springer Nature, Cham, 2026.

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

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

Teaching methods	Lectures with the use of modern means of presentation, discussion of student solutions to assigned tasks, consultations. Practical classes are held in a computer-equipped laboratory.

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			
Projects	25		

Specification for the book of courses

Study program			Control Systems / Automatic Control Control Systems / Computer Control Systems and Measurement Techniques	
Type and level of studies			Master Academic 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)**	Obligatory / Elective
Prerequisites	None			
Course objectives	To enable students to understand the architecture, operation, and development of embedded systems, as well as to independently create and run simple Linux-based systems on embedded platforms such as the BeagleBone Black.			
Course outcomes	Upon successful completion of this course, the student will be able to: a) explain the architecture and components of embedded systems, b) select and apply appropriate development tools and compilers (toolchains) for cross-compiling programs intended for embedded environments, c) understand and configure the system boot process, d) customize and compile the Linux kernel for an embedded platform, e) install and use a Linux SDK and libraries for embedded application development, f) create and test a simple kernel driver.			
Course outline				
Theoretical teaching	Introduction to embedded systems: hardware components, software. Architecture: CPU, memory, peripherals, I/O interfaces. BeagleBone Black platform: AM335x SoC (ARM Cortex-A8 processor). Operating systems: types, selection criteria. Programming tools and toolchain: cross-compilation, GCC, binutils, make. Boot process: U-Boot bootloader. Linux Kernel: source tree structure, configuration, compilation. Device Tree: structure, compilation. File system: directories, minimal rootfs. Build systems: OpenEmbedded, Yocto, Buildroot. Flash memory and storage: eMMC, NAND/NOR Flash, file systems. Scripts: bootable SD cards. Linux SDK and libraries: OpenEmbedded SDK, glibc, uClibc. Linux device drivers: device classes and modules, user-space drivers, writing kernel-space drivers.			
Practical teaching (exercises, OFE, study and research work)	1) Working in the Linux environment – basic commands, file system structures; 2) Introduction to the BeagleBone Black development board, connection and setup; 3) Installation of the development environment, toolchain, cross-compilation; 4) Writing and using Makefile scripts, project organization; 5) Serial communication and system preparation – working via UART; 6) Preparing the SD card for booting Linux on the embedded system; 7) U-Boot source code – U-Boot configuration; 8) Linux kernel source code – configuration and compilation; 9) Setting boot parameters, hardware description (Device Tree); 10) Creating the rootfs; integrating the rootfs, kernel, and DTB into the SD image; 11) Running Embedded Linux on the BeagleBone Black; 12) Using the Linux SDK (OpenEmbedded SDK); 13) Creating and loading a simple Linux Kernel module; 14) Development of a simple character device driver.			
Textbooks/references				
1	Frank Vasquez, Chris Simmonds, Mastering Embedded Linux Programming, Packt Publishing, 2021.			
2	Derek Molloy, Exploring BeagleBone: Tools and Techniques for Building with Embedded Linux, Wiley, 2019.			
3	Changyi Gu, Building Embedded Systems, Programmable Hardware, Apress, 2016.			
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	0	0
Teaching methods	Lectures; classroom exercises; laboratory exercises; homework assignments; project work; consultations			
Grade (maximum number of points 100)				
Pre-exam duties		**Points**	**Final exam**	**Points**

Activity during lectures	5	**Written exam**	25
Exercises	25	**Oral exam**	25
Colloquia	20		
Projects			

Specification for the book of courses

Study program	Control Systems / Computer Control Systems and Measurement Techniques		
Type and level of studies	Master Academic Studies		
The name of the course	Medical Electronics		
Lecturer (for lectures)	Jovanović D. Borisav		
Lecturer/associate (for exercises)	Jovanović D. Borisav		
Lecturer/associate (for OFE)	Jovanović D. Borisav		
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	None
Course objectives	Acquiring knowledge of the fundamentals of electronics in medicine, the use of electrical signals in medical applications, and the most important characteristics of medical electronic devices: reliability and safety.
Course outcomes	Acquiring knowledge of the application of electronic signals in medicine and gaining competence in designing electronic circuits applicable to medical devices.
Course outline	
Theoretical teaching	Sources of bioelectric potential. The heart's electrical conduction system. Standard ECG leads. Devices for recording ECG, EMG, and EEG signals. Biopotential amplifiers. Instrumentation biopotential amplifier. Bandwidth of biopotential amplifiers. Biopotential signal filtering (design of low-pass filters, construction of active and passive filters, harmonic suppression circuits). Pacemaker impulse detection, signal slew rate limiting circuits. Hardware for digital processing of biopotential signals. Design of digital filters for biopotential signal processing. Reliability and safety of medical electronic devices. Isolation of analog and digital signals. Design of power supply systems for medical devices.
Practical teaching (exercises, OFE, study and research work)	The knowledge gained in lectures is complemented by laboratory exercises. These include simulations of analog circuits for amplifying and filtering ECG, EEG, and EMG signals, as well as practical examples of PIC microcontroller programming. The PSpice simulator, part of the KiCad toolset, is used for circuit simulations. In the exercise focused on ECG device design, students write portions of microcontroller code that convert analog signals from the ECG amplifier output into digital form, then transmit them to a computer for display and further processing. Students acquire practical skills in digital ECG signal processing and digital filter design. One of the exercises includes the practical implementation of a Holter ECG device, with emphasis on developing firmware for the PIC microcontroller that forms part of the Holter device. For the purposes of these exercises, custom printed circuit boards have been developed to replicate actual medical devices. A dedicated application has also been created that runs under the Linux operating system and includes most functionalities of a patient monitor.
Textbooks/references	
1	D. Prutchi, M. Norris, Design and Development of Medical Electronic Intrumentation, John Willey and Sons, Inc. 2005
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
2	1	1	0	0

Teaching methods	Lectures with the use of a projector, audio-based exercises, computer-based laboratory work, consultations, and individual projects.

Grade (maximum number of points 100)

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

Specification for the book of courses

Study program	Control Systems / Computer Control Systems and Measurement Techniques		
Type and level of studies	Master Academic Studies		
The name of the course	Telemedical measurement systems		
Lecturer (for lectures)	Živanović B. Dragan, Dinčić R. Milan		
Lecturer/associate (for exercises)			
Lecturer/associate (for OFE)	Đorđević-Kozarov R. Jelena, Stojanović S. Milica		
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	None
Course objectives	The course aims to provide students with the knowledge and skills required to understand the principles, architecture, and application of telemedicine measurement systems, as well as methods for the acquisition, archiving, compression, transmission, and exchange of biomedical data and signals. Students acquire knowledge of telecommunication technologies, standards for the integration of medical information systems, and the security, legal, ethical, and organizational aspects of telemedicine.
Course outcomes	Upon successful completion of the course, the student is able to explain the operating principles of telemedicine measurement systems; analyze different types of biomedical data and signals; evaluate the requirements for their archiving, compression, transmission, and retrieval; apply HL7, DICOM, and PACS standards in the integration of medical information systems; analyze telecommunication requirements and communication models used in telemedicine; and evaluate the security, legal, ethical, and economic aspects of telemedicine technologies.
Course outline	
Theoretical teaching	Basic principles. Biomedical data and signals. Types of signals in medicine: alphanumeric data, one-dimensional, two-dimensional, three-dimensional signals. Characteristics of signals from different modalities. Data compression. Archiving, transmission and search of data. Connecting various devices to the PACS image archiving and transfer system. Standards for displaying and exchanging demographic data HL7 and medical images DICOM. Telecommunication requirements in telemedicine. Types of communication and networks, protocol hierarchy. Bandwidth for various transmission needs. Connecting remote users. Delayed communication: store-and-forward and interactive communication. Confidentiality, privacy and data protection. Basic telemedicine services. Economic, legal and ethical aspects of telemedicine.
Practical teaching (exercises, OFE, study and research work)	Practical training includes classroom exercises accompanying the lectures, analysis of the architecture and operating principles of telemedicine measurement systems, demonstrations of the application of HL7, DICOM, and PACS standards in medical information systems, as well as demonstration sessions in healthcare institutions, subject to the availability of appropriate technical and organizational conditions. Students complete seminar papers and project assignments involving the analysis, design, and evaluation of telemedicine measurement systems and services.
Textbooks/references	
1	Gogia, S. (Ed.), Fundamentals of Telemedicine and Telehealth, Elsevier, Amsterdam, 2019.
2	Fong, B., Fong, A. C. M., Li, C. K., Telemedicine Technologies: Information Technologies in Medicine and Digital Health, 2nd ed., Wiley, Hoboken, NJ, 2020.
3	van Ooijen, P. M. A. (Ed.), Basic Knowledge of Medical Imaging Informatics: Undergraduate Level and Level I, Springer, Cham, 2021.
4	Huang, H. K., PACS-Based Multimedia Imaging Informatics: Basic Principles and Applications, 3rd ed., Wiley, Hoboken, NJ, 2018.
5	Rashid, T. A., Chakraborty, C., Fraser, K. (Eds.), Advances in Telemedicine for Health Monitoring: Technologies, Design and Applications, Institution of Engineering and Technology, London, 2020.

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

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

Teaching methods	Teaching is carried out through lectures supported by multimedia presentations and demonstrations, classroom exercises, analysis and discussion of scientific papers and case studies, demonstrations of contemporary telemedicine systems and platforms, and the independent preparation and presentation of seminar papers and project assignments.		
Grade (maximum number of points 100)			
Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures	10	**Written exam**	25
Exercises		**Oral exam**	35
Colloquia			
Projects	30		

Specification for the book of courses

Study program	Control Systems / Computer Control Systems and Measurement Techniques		
Type and level of studies	Master Academic Studies		
The name of the course	Brain-Computer Interface systems in medicine		
Lecturer (for lectures)	Živanović B. Dragan, Simić M. Milan		
Lecturer/associate (for exercises)			
Lecturer/associate (for OFE)	Đorđević-Kozarov R. Jelena, Stojanović S. Milica		
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	None
Course objectives	The course aims to provide students with the knowledge and skills required to understand the principles, architecture, and classification of Brain–Computer Interface (BCI) systems, as well as to analyze, design, and apply modern invasive, partially invasive, and non-invasive BCI technologies in medicine. Students acquire knowledge of methods for brain signal acquisition and processing, the operating principles of various BCI technologies, and their applications in rehabilitation, assistive technologies, diagnostics, and advanced medical systems.
Course outcomes	Upon successful completion of the course, the student is able to explain the operating principles and classification of Brain–Computer Interface (BCI) systems; analyze the advantages, limitations, and application areas of different BCI technologies; compare invasive, partially invasive, and non-invasive approaches to brain signal acquisition; analyze methods based on electroencephalography (EEG), electrocorticography (ECoG), magnetoencephalography (MEG), and functional magnetic resonance imaging (fMRI); critically evaluate recent scientific advances and emerging trends in the field of Brain–Computer Interface technologies; and design, analyze, and evaluate medical systems based on Brain–Computer Interface technologies for clinical and assistive applications.
Course outline	
Theoretical teaching	Origin of Brain Computer Interface (BCI) systems. Differences between BCI systems and neural prostheses. BCI systems researches with animals. BCI systems researches with people. Invasive BCI systems. Improvement of visual features using BCI system. Improvement of movements using BCI system. Partly invasive BCI systems based electrocorticography (ECOG). Noninvasive BCI systems based on electroencephalography (EEG). Noninvasive BCI systems based on magnetoencephalography (MEG). Noninvasive BCI systems based devices with functional magnetic-resonance imaging. Researches of BCI systems based on receiver ELF / SLF / ULF frequencies. Commercial BCI systems for people with disabilities.
Practical teaching (exercises, OFE, study and research work)	Practical training includes laboratory and classroom exercises covering Brain–Computer Interface systems, analysis of the architecture and operating principles of invasive and non-invasive BCI technologies, acquisition, visualization, and analysis of EEG and other neurophysiological signals, and the use of modern software tools and commercial BCI platforms. Students complete project assignments involving the analysis, design, and evaluation of Brain–Computer Interface-based medical systems for applications in rehabilitation, assistive technologies, and human–computer interaction.
Textbooks/references	
1	J. R. Wolpaw, E. Winter Wolpaw (Eds.), Brain-Computer Interfaces: Principles and Practice, Oxford University Press, Oxford, 2012.
2	Naseer, N., Niazi, I. K., Santosa, H. (Eds.), Signal Processing for Brain–Computer Interfaces, MDPI Books, Basel, 2024.
3	C. S. Nam, A. Nijholt, F. Lotte (Eds.), Brain-Computer Interfaces Handbook: Technological and Theoretical Advances, CRC Press, Boca Raton, 2018.
4	B. He (Ed.), Neural Engineering, 3rd ed., Springer, Cham, 2020.
5	N. F. Ramsey, J. del R. Millán (Eds.), Brain-Computer Interfaces, Progress in Brain Research, Vol. 168, Elsevier, Amsterdam, 2020.

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

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

Teaching methods	Teaching is carried out through lectures supported by multimedia presentations and demonstrations, laboratory and classroom exercises, analysis and discussion of scientific papers and case studies, demonstrations of contemporary Brain–Computer Interface systems, and the independent development and presentation of project assignments related to medical BCI systems.

Grade (maximum number of points 100)			
Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures	10	**Written exam**	25
Exercises		**Oral exam**	35
Colloquia			
Projects	30		

Specification for the book of courses

Study program			Control Systems / Automatic Control Control Systems / Computer Control Systems and Measurement Techniques		
Type and level of studies			Master Academic Studies		
The name of the course			Mobile Communication Systems		
Lecturer (for lectures)			Marinković D. Zlatica		
Lecturer/associate (for exercises)			Mladenović M. Ksenija		
Lecturer/associate (for OFE)			Stošić P. Biljana		
Number of ECTS		5	**Course status (obligatory/elective)**	Obligatory / Elective	
Prerequisites	None				
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 communications. 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. Ability of recognizing and discussing possibile applications of mobile communications systems in different fields, such as medicine, IoT systems, etc.				
Course outline					
Theoretical teaching	Signal propagation in mobile communications. Principles of mobile communications. Evolution of the standards of mobile communication systems. Cellular approach. Signal propagation in mobile communications. GSM, GPRS and UMTS systems. Packet data transfer. HSPA and HSPA + systems. LTE and LTE Advanced system. 5G mobile systems. Quality of services tests in mobile networks (benchmarking). Mobile communications applications in IoT systems. Mobile systems applications in industry and system control. Applications of mobile communications in systems of connected vehicles. Mobile communications in medical applications (mHealth).				
Practical teaching (exercises, OFE, study and research work)	Solving practical problems in the field of mobile communication systems. Introduction to practical methods for testing the quality of services of mobile networks. Case studies – applications of mobile communications in IoT systems, systems of connected vehicels, health systems, industry, etc. Introduction to mobile applications development.				
Textbooks/references					
1	D.P.Agrawal, Q.A.Zeng, Introduction to Wireless and Mobile Systems, Thomson, 2006				
2	J. Rodriguez, “Fundamentals of 5G Mobile Networks”, Wiley, ISBN: 978-1-118-86752, 2015				
3	International (ETSI) Standards for Quality of Service Testing in Mobile Networks				
4	Selected book chapters and articles on the most recent applications of mobile communication systems				
5	Z. Marinkovič, B. Stošić, "Mobile Communication Systems", Power Point Slides, Faculty of Electronic Engineering, 2025.				
Number of classes of active education per week during semester/trimester/year					
Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**	
2	2	1	0	0	
Teaching methods	Lectures, exercises, practical exercises, consultations				
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					
Projects		50			

Specification for the book of courses

Study program	Control Systems		
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	6	**Course status (obligatory/elective)**	Obligatory

Prerequisites	
Course objectives	Application of fundamental, theoretical-methodological, scientific-professional, and professional-applicative knowledge and methods to solving specific problems. The student analyzes the problem, its structure, and complexity, and based on the conducted analyses, draws conclusions about possible solutions. By studying the literature, the student becomes familiar with methods intended for solving similar tasks and with engineering practices in addressing them.
Course outcomes	Enabling students to independently apply previously acquired knowledge from various fields they have studied, in order to understand the structure of a given problem and to perform a systematic analysis aimed at drawing conclusions about possible directions for its resolution. Through independent use of literature, students expand their knowledge by studying different methods and papers related to similar problems. In this way, students develop the ability to conduct analyses and identify problems within the given area of study. Through the practical application of acquired knowledge, students develop the ability to recognize the role and position of engineers in their chosen field, the need for collaboration with other professions, and the importance of teamwork.
Course outline	
Theoretical teaching	It is individually structured in accordance with the requirements of the specific diploma or master's thesis, its complexity, and structure. Based on their interests and preferences, the student selects the area of study and the supervising professor from the list of faculty members in the study program, who defines the specific task. The student studies professional literature, technical and scientific papers dealing with similar topics, conducts analyses to find a solution to the specific task, or performs certain experiments in the laboratory. The study work also includes actively following primary research findings, organizing and conducting experiments, numerical simulations and statistical data processing, and writing a seminar paper within the narrower scientific-teaching field related to the topic of the independent research work.
Practical teaching (exercises, OFE, study and research work)	
Textbooks/references	
1	University of Niš, Faculty of Electronic Engineering, Guidelines and Template for the Preparation of Final, Diploma and Master's Theses, Niš, available at: https://sip.elfak.ni.ac.rs/downloads/obrasci/forma-diplomski-rad.pdf
2	T. M. Young, Technical Writing A-Z: A Commonsense Guide to Engineering Reports and Theses, ASME Press, New York, 2005, ISBN 978-0-7918-0236-6.
3	E. J. Rothwell and M. J. Cloud, Engineering Writing by Design: Creating Formal Documents of Lasting Value, CRC Press, 2017, ISBN 9781482234329.
4	H. El Chaarani and Z. El Abiad, How to Write a Master Thesis: The Easy Handbook Guide, New Edition, Journal of Contemporary Research in Business Administration and Economic Sciences, 2021.
5	

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

Lectures	Exercises	OFE	Study and research work	Other classes
			12	

Teaching methods	Mentoring and individual consultations.		
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	
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	14	**Course status (obligatory/elective)**	Obligatory

Prerequisites	
Course objectives	The purpose of the Master thesis is to integrate, validate, and apply the knowledge acquired during Master academic studies. The student is given the opportunity to demonstrate the ability to independently carry out a project, which may be of a practical, research, or theoretical-methodological nature. The student also gains experience in presenting their work in written form and through an oral presentation during the thesis defense.
Course outcomes	Ability to lead an independent project, formulate and analyze problems, critically evaluate possible solutions, and review literature in the given field. Application of acquired engineering and design knowledge and skills to problem-solving, taking into account the complexity, cost, reliability, and efficiency of the solution. Ability to write the thesis in the prescribed format. Ability to clearly present and explain the completed project through an oral defense.
Course outline	
Theoretical teaching	The Master thesis is an independent research, practical, or theoretical-methodological work by the student, aligned with the level of study, through which the student explores a specific area by reviewing literature and adopting the research or design methodology necessary for completing the thesis. In the course of writing the thesis, the student applies both practical and theoretical knowledge acquired during the studies. The written thesis typically includes an introductory chapter, problem definition, overview of the field and existing solutions, proposed and described solution, conclusion, and references. A public oral defense of the thesis is organized before a committee of three members, one of whom is the thesis mentor. During the oral defense, the candidate presents the results of its work and answers the questions posed by the committee members, thereby demonstrating the ability to orally present its project.
Practical teaching (exercises, OFE, study and research work)	
Textbooks/references	
1	University of Niš, Faculty of Electronic Engineering, Guidelines and Template for the Preparation of Final, Diploma and Master's Theses, Niš, available at: https://sip.elfak.ni.ac.rs/downloads/obrasci/forma-diplomski-rad.pdf
2	T. M. Young, Technical Writing A-Z: A Commonsense Guide to Engineering Reports and Theses, ASME Press, New York, 2005, ISBN 978-0-7918-0236-6.
3	E. J. Rothwell and M. J. Cloud, Engineering Writing by Design: Creating Formal Documents of Lasting Value, CRC Press, 2017, ISBN 9781482234329.
4	H. El Chaarani and Z. El Abiad, How to Write a Master Thesis: The Easy Handbook Guide, New Edition, Journal of Contemporary Research in Business Administration and Economic Sciences, 2021.
5	

Number of classes of active education per week during semester/trimester/year				
Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
				2

Teaching methods	Mentoring and individual consultations.

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			