# Specification for the book of courses

| | | | |
|---|---|---|---|
| **Study program** | Electronics and Microsystems | | |
| **Module** | Electronics and Microsystems | | |
| **Type and level of studies** | Master studies | | |
| **The name of the course** | Electronic Control Circuits for Converters | | |
| **Lecturer (for lectures)** | Mančić D. Dragan | | |
| **Lecturer/associate (for exercises)** | Jovanović D. Igor | | |
| **Lecturer/associate (for OFE)** | | | |
| **Number of ECTS** | 5 | **Course status (obligatory/elective)** | Elective |

| | |
|---|---|
| **Prerequisites** | |
| **Course objectives** | Acquiring the fundamental knowledge about the control principles for power converters, methods of their realisation and practical application. |
| **Course outcomes** | Theoretical knowledge on the control of power converters. Mastering the techniques of development, realisation and application of the various control methods for power converters. |
| **Course outline** | |
| **Theoretical teaching** | Driver circuits for power electronic components (thyristor, bipolar transistor, MOSFET, IGBT, GTO). Control circuits with phase control. Control circuits for AC voltage controllers. Control circuits for rectifiers. Control circuits for choppers. Control circuits for inverters. Control circuits for cycloconverters. Professional systems in power electronics. Electromagnetic compatibility of power electronic devices. |
| **Practical teaching (exercises, OFE, study and research** | Drivers. Control of rectifiers. Control of choppers. Control of inverters. Control of a system for speed regulation of an asynchronous motor. |
| **Textbooks/references** | |
| 1 | N.Mohan, T.M.Undeland, W.P.Robbins, "Power electronics: Converters, Applications, and Design", John Wiley & Sons., New York, 2007. |
| 2 | R.W.Erickson, D.Maksimovic, "Fundamentals of Power Electronics, Second Edition", Kluwer Academic Publishers, New York, 2004. |
| 3 | M.H.Rashid, "Power Electronics Handbook", Elsevier Science, 2017. |
| 4 | S.Manias, Power Electronics and Motor Drive Systems", Academic Press, 2016. |
| 5 | L.A.Kumar, A.Kalaiarasi, Y.U.Maheswari, “Power Electronics with MATLAB”, Cambridge University Press, Cambridge, 2018. |

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

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

| | |
|---|---|
| **Teaching methods** | Lectures; Auditorial exercises; Laboratory 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** | 15 | **Oral exam** | 20 |
| **Colloquia** | 20 | | |
| **Projects** | 15 | | |

# Specification for the book of courses

| | | | |
|---|---|---|---|
| **Study program** | Electrical Power Engineering | | |
| **Module** | Electrical Power Engineering | | |
| **Type and level of studies** | Master studies | | |
| **The name of the course** | Electrical Drive Control | | |
| **Lecturer (for lectures)** | Antić S. Dragan, Mitić B. Darko | | |
| **Lecturer/associate (for exercises)** | Danković B. Nikola | | |
| **Lecturer/associate (for OFE)** | | | |
| **Number of ECTS** 5 | **Course status (obligatory/elective)** | Elective | |
| **Prerequisites** | | | |
| **Course objectives** | Introduction to the different types of controllers, control of electric drives coordinates, structures of controlled electrical drive, design methods of controlled electrical drives. | | |
| **Course outcomes** | Knowledge about the types of controllers and their application (current, torque, speed and position control), design (method of poles placement, method of symmetric and technical optimum), frequency control of induction motor, vector control. | | |
| **Course outline** | | | |
| **Theoretical teaching** | Definition, significance, application and types of regulated electric drives. Dynamical models of DC motors, asynchronous and synchronous motors. Dynamical mdel of elctrical drive. Regulation of electric drive coordinates (torque, current, speed, position). Typical structures of the regulated electrical drive. Control of asynchronous motor. Frequency control of asynchronous motor. FOC principle. Controller design methods for electrical drives. Classical methods. Modern methods. Regulation of electromotor drives using linear regulators and phase compensators. Design of compensators and linear regulators in the frequency domain, as well as using the methods of pole-placement method, zero-pole canceling, technical and symmetric optimum. Design of state feedback control. Design of observer. Digital implementation of control algorithms. Methods of numerical integration. Discrete-time equivalents of linear analog controllers and filters. Design of compensators in a discrete-time domain. | | |
| **Practical teaching (exercises, OFE, study and research work)** | Modeling of electrical drive based on Hamilton's principle and Lagrange-Euler equations. Time responses of electrical drives. Z-transformation, inverse Z-transformation. Discrete transfer function. Discrete-time model of a system in state space. Stability of discrete-time control systems. Speed and position control of DC motors by using linear (PI, PD and PID) regulators and phase compensators. Choice of controller type and practical tuning of linear controller parameters. Control of asynchronous motor, Control of asynchronous motor with frequency regulator. Vector control of the asynchronous motor. | | |
| **Textbooks/references** | | | |
| 1 | V. Vučković, “Electrical Drives“, Akademska misao, 2002. (in Serbian) | | |
| 2 | I. Boldea, S.A. Nasar: “Vector Control of AC Drives“, CRC Press, 1992. | | |
| 3 | W. Leonhard: “Control of Electrical Drives“, Springer-Verlag, 1996. | | |
| 4 | M.R. Stojić, DigitalControl Systems, Академска мисао, Београд, 2004. (in Serbian) | | |
| 5 | Dragan Antić, Darko Mitić, Zoran Jovanović, "Electrical drive control - workbook", Faculty of Electronic Engineering, Niš, 2010. (in Serbian) | | |

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

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

| | |
|---|---|
| **Teaching methods** | Lectures; Auditory exercises; Computer exercises; Consultations |

**Grade (maximum number of points 100)**

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

# Specification for the book of courses

| | | | |
|---|---|---|---|
| **Study program** | Electrical Power Engineering | | |
| **Module** | Electrical Power Engineering | | |
| **Type and level of studies** | Master studies | | |
| **The name of the course** | Selected Chapters of High Voltage Substations | | |
| **Lecturer (for lectures)** | Korunović M. Lidija | | |
| **Lecturer/associate (for exercises)** | Anastasijević B. Ivan | | |
| **Lecturer/associate (for OFE)** | | | |
| **Number of ECTS** | 5 | **Course status (obligatory/elective)** | Elective |

| | |
|---|---|
| **Prerequisites** | |
| **Course objectives** | Introducing excitation systems, extinction of the field, and excitation control of synchronous generators, to the students. Introduction of the calculation method for time-dependent change of the fault current on the basis of complete expression, time-dependent change of the current during unbalanced faults and the conditions of equipment selection. Additionally, the influence of overhead lines and cables on fault current, as well as the reliability of networks and high voltage substations, are introduced to the students. |
| **Course outcomes** | Students are enabled to perform calculation of fault current on the basis of the complete expression. Additionally, students are enabled to specify the influence of excitation current on fault current. Students know to determine the time-dependent change of fault current during unbalanced faults. They are also enabled to quantify the influence of lines on the reduction of grounding current during the fault. Students know to determine equivalent reliability parameters of networks and high voltage power substations. |
| **Course outline** | |
| **Theoretical teaching** | Excitation systems of synchronous generators. Extinction of generator field. Basic definitions regarding systems for excitation control, mathematical models. Complete expression of fault current. The influence of excitation control on fault current. Unbalanced faults and symmetrical components - corresponding equations. Unbalanced short-circuits at generator busbars. Critical conditions for equipment testing - operation condition of the system, fault type, fault location and critical schema of high voltage substation. Overhead lines as the elements of grounding system. Cables as the elements of grounding system. Reliability of networks and high voltage substations. Unrecoverable systems. Recoverable systems. Reliability of electric power networks. Reliability of high voltage substations. |
| **Practical teaching (exercises, OFE, study and research** | Exercises include the solution of computational tasks in the areas of theoretical lectures, and the solution of illustrative examples on the computer. |
| **Textbooks/references** | |
| 1 | J. Nahman, V. Mijailović, Selected Chapters of High Voltage Substations (in Serbian), School of Electrical Engineering, Academic mind, Belgrade, 2002. |
| 2 | J. Nahman, D. Salamon, V. Mijailović, High Voltage Substations - Workbook with Solved Problems with Appendixes (in Serbian), Academic mind, Belgrade, 2002. |
| 3 | J. Nahman, Short-circuit Currents in Electric Power Systems (in Serbian), School of Electrical Engineering, Science, Belgrade, 1996. |
| 4 | J. Nahman, V. Mijailović, Reliability of Electric Power Distribution Systems (in Serbian), Academic mind, Belgrade, 2009. |
| 5 | M. Đurić, Basis of Voltage and Frequency Regulation in Electric Power System (in Serbian), Beopress, Belgrade, 2003. |

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

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

| | |
|---|---|
| **Teaching methods** | Theoretical teaching includes the classic lectures and the lectures in electronic form. Exercises include the solution of computational tasks on the board and using the projector. |

**Grade (maximum number of points 100)**

| **Pre-exam duties** | **Points** | **Final exam** | **Points** |
|---|---|---|---|
| **Activity during lectures** | | **Written exam** | 25 |
| **Exercises** | | **Oral exam** | 25 |
| **Colloquia** | 50 | | |
| **Projects** | | | |

# Specification for the book of courses

| | | | |
|---|---|---|---|
| **Study program** | Electrical Power Engineering | | |
| **Module** | Electrical Power Engineering | | |
| **Type and level of studies** | Master studies | | |
| **The name of the course** | Electromagnetic Compatibility in Power Engineering | | |
| **Lecturer (for lectures)** | Javor L. Vesna | | |
| **Lecturer/associate (for exercises)** | Javor L. Vesna | | |
| **Lecturer/associate (for OFE)** | | | |
| **Number of ECTS** 5 | **Course status (obligatory/elective)** | Elective | |
| **Prerequisites** | No | | |
| **Course objectives** | Teaching students about basic principles and techniques of electromagnetic compatibility (EMC) and testing equipment of EMC laboratories. Study of EMC standards. Application of principles and techniques of EMC in the field of power engineering. | | |
| **Course outcomes** | Students' ability to apply electromagnetic compatibility (EMC) standards, procedures for testing EMC in the laboratory, principles and techniques of EMC in the field of power engineering. | | |
| **Course outline** | | | |
| **Theoretical teaching** | Electromagnetic compatibility (EMC), interference (EMI), susceptibility (EMS), disturbance (EMD). Types of EMC problems. Requirements, standards and directives. Standardization bodies. Limits and benefits of EMC requirements application. CE marking of conformity with European standards. Design and testing of circuits, devices and systems in accordance with EMC requirements. Basic parameters of power quality in low voltage (LV) and middle voltage (MV) network. EMC with power supply network. Sources and levels of interference. Radiated and conductive emissions. Laboratory equipment for EMC testing and test methods. LISN, measuring receivers, network analyzers, spectrum analyzers, antennas and probes for EMC testing. Elementary electric and elementary magnetic dipole. Measurement sites for EMC testing: Faraday cage, reverberation, anechoic and semianechoic chamber, TEM and GTEM cells. Differential mode and common mode currents. EMC principles and techniques: shielding (shielding efficiency, holes and slots), grounding, filtering (passive LP, HP, BP and BS filters), non-ideal behavior of resistors, capacitors and inductors, selection according to EMC requirements. Ferrites and ferrite chokes. Losses due to absorption and reflection. Practical examples of solving EMC problems. | | |
| **Practical teaching (exercises, OFE, study and research** | Exercises and a visit to the EMC testing laboratory. | | |
| **Textbooks/references** | | | |
| 1 | Ott H. W., "Electromagnetic compatibility engineering," John Wiley & Sons, 2009. | | |
| 2 | Williams T., "Electromagnetic compatibility for product designers," Newnes, 2016. | | |
| 3 | Lattarulo F., "Electromagnetic compatibility in power systems," Elsevier, 2007. | | |
| 4 | Keiser K., "Electromagnetic compatibility handbook," CRC Press, 2004. | | |
| 5 | Đorđević A., Olćan D., "Electromagnetic compatibility testing," (in Serbian), Academic Mind, Belgrade, 2012. | | |

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

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

| | |
|---|---|
| **Teaching methods** | Lectures, exercises and consultations. |

**Grade (maximum number of points 100)**

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

# Specification for the book of courses

| | | | |
|---|---|---|---|
| **Study program** | Electrical Power Engineering | | |
| **Module** | Electrical Power Engineering | | |
| **Type and level of studies** | Master studies | | |
| **The name of the course** | Lightning Protection | | |
| **Lecturer (for lectures)** | Javor L. Vesna | | |
| **Lecturer/associate (for exercises)** | Vučković D. Dragan | | |
| **Lecturer/associate (for OFE)** | | | |
| **Number of ECTS** | 5 | **Course status (obligatory/elective)** | Elective |

| | |
|---|---|
| **Prerequisites** | No |
| **Course objectives** | Acquisition of basic knowledge in the field of lightning protection of the elements of electric power systems and objects. |
| **Course outcomes** | Acquired theoretical knowledge, as well as the ability to assess the needs and application of lightning protection measures for objects and elements of electric power systems. |
| **Course outline** | |
| **Theoretical teaching** | Classification of overvoltages in electric power systems (EPS). Components and types of lightning discharges. Characteristic parameters, standard waveform of lightning currents and approximation functions. Models of lightning discharges. Meteorological parameters of significance for lightning protection. Indirect and direct lightning discharges to EPS elements (lines, pillars, grounding wires). Mechanical and thermal effects of lightning discharges. Modeling of the incident travelling waves. Modeling of conductors, poles and groundings in the analysis of lightning overvoltages. Reverse leap. Modeling of the surge waves on lines. Direct and inverse waves. Coefficients of refraction and reflection. Equivalent wave. Modeling of lumped elements and equipment. Petersen's rule. Network diagram method. Bergeron's grafoanalytic method. Lightning protection of objects. External and internal lightning protection system. Protected angle method. Rolling sphere method. Method of the wire mesh and Faraday cage. Measures for the protection of devices and equipment. The concept of lightning protection zones. Surge arresters, selection and placement. Assessment of risks and lightning protection measures for photovoltaic power plants. Assessment of risk and lightning protection measures for wind generators. Computer programs for the simulation of lightning overvoltages. |
| **Practical teaching (exercises, OFE, study and research** | Practical lectures are realized through computational exercises in order to perform the calculation of lightning overvoltages in power systems, the application of numerical methods and the use of computer programs. |
| **Textbooks/references** | |
| 1 | Rakov V. A., Uman M. A. "Lightning physics and effects“, Cambridge Univ. Press, UK, University Press, 2005. |
| 2 | Javor V., "Lightning electromagnetic field," (in both Serbian and English), Andrejević Endowment, Belgrade, 2011. |
| 3 | Betz H.-D., Schmidt K., Oetttinger W.P, Wirz M. "Lightning: principles, instruments and application“, Springer, Dordrecht, NL, 2008. |
| 4 | Savić M., "High voltage technique: lightning overvoltages - collection of problems", (in Serbian), Građevinska knjiga, Belgrade, 1982. |
| 5 | Stojković Z., "Computer aided design in power engineering," (in Serbian), Academic Mind, Belgrade, 2002. |

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

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

| | |
|---|---|
| **Teaching methods** | Lectures, exercises and consultations. |

**Grade (maximum number of points 100)**

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

# Specification for the book of courses

| | | | | |
|---|---|---|---|---|
| **Study program** | | Electrical Power Engineering | | |
| **Module** | | Electrical Power Engineering | | |
| **Type and level of studies** | | Master studies | | |
| **The name of the course** | | Electricity Market and Deregulation | | |
| **Lecturer (for lectures)** | | Tasić S. Dragan, Janjić D. Aleksandar | | |
| **Lecturer/associate (for exercises)** | | Vučković D. Dragan | | |
| **Lecturer/associate (for OFE)** | | | | |
| **Number of ECTS** | 5 | **Course status (obligatory/elective)** | Elective | |
| **Prerequisites** | | | | |
| **Course objectives** | Introduction to the basic knowledge about the principles of regulated and deregulated electricity market and basic market models. | | | |
| **Course outcomes** | Upon completion of this course, students will know a modern organization and functioning of the deregulated electric power industry in the world, as well as the organization and operation of electric power in Serbia. There will also be trained in making power balancer, work on power exchange, working in the control center, the work of the independent system operator, the regulatory agency, the development of optimal solutions for a variety of markets and time periods, etc. | | | |
| **Course outline** | | | | |
| **Theoretical teaching** | The basic structure and regulation of the electric power industry, the causes and motives of deregulation, the principles of electric power industry restructuring and deregulation. Deregulation and restructuring of the electric power industry, technical and economic conditions and participants. The experience of deregulation in the world, the EU regulations on the electricity market. Regulation and deregulation in the state of Serbia. The organization and functioning of the electricity market. Bilateral market, central, and mixed market balance. Principles of regulation of monopoly networks and operating costs. Electricity transit. Transmission network congestion. The main regulatory models | | | |
| **Practical teaching (exercises, OFE, study and research** | Practical work with systems for the power market simulation. Composing of electrical energy balances Simulation of a certain market model and optimization of market functions, using the appropriate software packages. | | | |
| **Textbooks/references** | | | | |
| 1 | N. Katic, A. Tausan, M. Adamovic, "Power systems under the deregulated market conditions", (in Serbian) FTN Novi Sad, 2012. | | | |
| 2 | J. Momoh, L. Mili, Economic Market Design and Planning for Electric Power Systems, IEEE, John Wiley &Sons, 2010. | | | |
| 3 | H.L.Willis, L. Philips, Understanding Electric Utilities and Deregulation, Taylor & Francis, 2006 | | | |
| 4 | D. Kirschen, G. Strbac, Fundamentals of Power System Economics, John Wiley and Sons, 2004, USA | | | |
| 5 | | | | |
| **Number of classes of active education per week during semester/trimester/year** | | | | |
| **Lectures** | **Exercises** | **OFE** | **Study and research work** | **Other classes** |
| 2 | 2 | 0 | | |
| **Teaching methods** | Lectures, exercises, seminary work, consultations. | | | |
| **Grade (maximum number of points 100)** | | | | |
| **Pre-exam duties** | **Points** | **Final exam** | **Points** | |
| **Activity during lectures** | 5 | **Written exam** | 20 | |
| **Exercises** | | **Oral exam** | 20 | |
| **Colloquia** | | | | |
| **Projects** | 55 | | | |

# Specification for the book of courses

| | | | |
|---|---|---|---|
| **Study program** | Electrical Power Engineering | | |
| **Module** | Electrical Power Engineering | | |
| **Type and level of studies** | Master studies | | |
| **The name of the course** | Distribution Network Management | | |
| **Lecturer (for lectures)** | Janjić D. Aleksandar, Stajić P. Zoran | | |
| **Lecturer/associate (for exercises)** | Stojanović S. Miodrag | | |
| **Lecturer/associate (for OFE)** | | | |
| **Number of ECTS** 5 | **Course status (obligatory/elective)** | Elective | |

| | |
|---|---|
| **Prerequisites** | |
| **Course objectives** | Introduction to the principles of operation of a distribution network, network automation and different types of control systems. Introduction to the equipment for the network control. Introducing the concept of "smart grid". |
| **Course outcomes** | Students are trained to select the optimal strategy for network management, the selection of the hierarchical levels of management. Depending on the desired functionality, students are qualified for selection of equipment and methods of communication. |
| **Course outline** | |
| **Theoretical teaching** | The concept of control and automation in the distribution network. Different types of control systems. Concept and components of a "smart grid." The basic architecture of the system. The database structure and interfaces. Network Management Systems (DMS - Distribution Management System) and systems for real-time control. System for fault management in the network. Primary and secondary equipment for network management, equipment management and protection. Communication systems for the management of the distribution network. Communication interfaces and protocols. Standards for interoperability in advanced distribution networks |
| **Practical teaching (exercises, OFE, study and research** | Practical work with systems for automation and control of the distribution network. Setting the parameters of the SCADA system. Practical work with computer platforms for the distribution network management (DMS). Calculation, setting and monitoring of basic system parameters on DMS platform. |
| **Textbooks/references** | |
| 1 | J. Northcote-Green, „Control and Automation of Electrical Power Distribution System“ CRC Press, 2007 |
| 2 | J. Momoh, “Smart grid: Fundamentals of Design and Analysis” IEEE Press, 2011. |
| 3 | |
| 4 | |
| 5 | |

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

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

| | |
|---|---|
| **Teaching methods** | Teaching and computational examples are performed by lecturing, on a board. Students are doing their works independently, with the assistant supervision. Consulations. |

**Grade (maximum number of points 100)**

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

# Specification for the book of courses

| | | | | |
|---|---|---|---|---|
| **Study program** | | Electrical Power Engineering | | |
| **Module** | | Electrical Power Engineering | | |
| **Type and level of studies** | | Master studies | | |
| **The name of the course** | | Methods of optimization | | |
| **Lecturer (for lectures)** | | Marinković D. Slađana | | |
| **Lecturer/associate (for exercises)** | | Jovančić S. Vladan | | |
| **Lecturer/associate (for OFE)** | | | | |
| **Number of ECTS** | 5 | **Course status (obligatory/elective)** | Elective | |
| **Prerequisites** | | | | |
| **Course objectives** | Gaining basic mathematical knowledge of optimization and different optimization methods. Developing skills of mathematical modelling of real problems of practice, as well as solving them. | | | |
| **Course outcomes** | Students' competence to put the gained knowledge into practice. Competence to identify and define the optimization problems of practice, develop mathematical models, choose the appropriate methods for their solving and the application of methods. | | | |
| **Course outline** | | | | |
| **Theoretical teaching** | Defining the general optimization problem. Theoretical basis of optimization. Elements of convex analysis. Linear programming. Duality. Simplex method. Nonlinear programming. Unconstrained optimization. Searching methods. Gradient methods. Constrained optimization. Kuhn-Tucker conditions. Lagrange multipliers method. Penalty functions methods. Quadratic programming. Basis of multiobjective optimization. Overview of heuristic methods. | | | |
| **Practical teaching (exercises, OFE, study and research** | Exercises of knowledge gained in the lectures. Impementation of optimization algorithms by the appropriate software. | | | |
| **Textbooks/references** | | | | |
| 1 | Lj. M. Kocić, G. V. Milovanović, S. Marinković, Operational research, University of Niš, Faculty of Electronic Engineering, 2007.(Serbian) | | | |
| 2 | G.V. Milovanović, P.S. Stanimirović: Symbolic Implementation of Nonlinear Optimization, University of Niš, Faculty of Electronic Engineering, Niš, 2002 (Serbian). | | | |
| 3 | K. Y. Lee and M. A. El-Sharkawi, Modern Heuristic Optimization Techniques: Theory and Applications to Power Systems, Wiley, 2008. | | | |
| 4 | | | | |
| 5 | | | | |
| **Number of classes of active education per week during semester/trimester/year** | | | | |
| **Lectures** | **Exercises** | **OFE** | **Study and research work** | **Other classes** |
| 2 | 2 | 0 | | |
| **Teaching methods** | Lectures, exercises consultations. | | | |
| **Grade (maximum number of points 100)** | | | | |
| **Pre-exam duties** | **Points** | **Final exam** | **Points** | |
| **Activity during lectures** | | **Written exam** | 40 | |
| **Exercises** | | **Oral exam** | 20 | |
| **Colloquia** | | | | |
| **Projects** | 40 | | | |

# Specification for the book of courses

| | | | | |
|---|---|---|---|---|
| **Study program** | | Electrical Power Engineering | | |
| **Module** | | Electrical Power Engineering | | |
| **Type and level of studies** | | Master studies | | |
| **The name of the course** | | Computer Based Industrial Measurement Systems | | |
| **Lecturer (for lectures)** | | Denić B. Dragan, Radenković N. Dragan | | |
| **Lecturer/associate (for exercises)** | | Miljković S. Goran | | |
| **Lecturer/associate (for OFE)** | | Jocić V. Aleksandar | | |
| **Number of ECTS** | 5 | **Course status (obligatory/elective)** | Elective | |
| **Prerequisites** | | | | |
| **Course objectives** | The goal of the course is introduction with modern industrial computer based systems. Also, covering of needed knowledge about connection methods of classical and intelligent sensors with computer, and the realisation of virtual instruments and possibility of connection of such measurement systems to the Internet. | | | |
| **Course outcomes** | The student will be trained to realize and apply electronic circuits for measurement signal processing and sensors connection to the computer. Based on learning of programming language LabVIEW basics, the student will be trained to connect sensors using modern interface circuits and to realise some simpler examples of virtual instruments. The student will be capable to define basic characteristics and to work with modern industrial computer based measurement systems. | | | |
| **Course outline** | | | | |
| **Theoretical teaching** | Introduction to computer based measurement systems; basic block diagrams of one- and multi-channel measurement systems; measurements signals multiplexing; transducers and sensors in modern industrial measurement systems; development trends of sensors; integrated and smart sensors; intelligent measurement modules; measurement signal and data transmission; measurement signal conditioning circuits; two-wire transmitters; methods and systems for signal-to-noise ratio improvement; standard communication interfaces; explosion-proof instruments; grounding and shielding in automotive measurement systems, distributed measurement systems and connection to the Internet; automotive applications of telemetry systems; virtual instrumentation and LabVIEW software; industrial telemetry systems. | | | |
| **Practical teaching (exercises, OFE, study and research** | Introduction with programming language LabVIEW basics and the realisation of simpler virtual instruments. | | | |
| **Textbooks/references** | | | | |
| 1 | D. Denić, I. Ranđelović, D. Živanović, „Computer based industrial measurement systems“, Faculty of Electronic Engineering and WUS Austria, script, 2005. | | | |
| 2 | V. Drndarević, „Acquisition of measurement data using personal computer“, Institute of Nuclear Science „Vinča“, Belgrade, 1999. | | | |
| 3 | W. Nawrocki, „Measurement systems and sensors“, Artech House, 2005. | | | |
| 4 | D. Živanović, D. Denić, G. Miljković. "Computer based industrial measurement systems - laboratory exercises", Faculty of Electronic Engineering, Niš, 2011. | | | |
| 5 | M. Bhuyan, “Intelligent instrumentation, principles and applications”, CRC Press, 2011. | | | |
| **Number of classes of active education per week during semester/trimester/year** | | | | |
| **Lectures** | **Exercises** | **OFE** | **Study and research work** | **Other classes** |
| 2 | 1 | 1 | | |
| **Teaching methods** | Theoretical teaching is performed with modern presentation devices and with using of free scrypt material. Practical training is performed in computer equipped laboratory. | | | |
| **Grade (maximum number of points 100)** | | | | |
| **Pre-exam duties** | **Points** | **Final exam** | **Points** | |
| **Activity during lectures** | 5 | **Written exam** | 20 | |
| **Exercises** | 30 | **Oral exam** | 15 | |
| **Colloquia** | 30 | | | |
| **Projects** | | | | |

# Specification for the book of courses

| | | | |
|---|---|---|---|
| **Study program** | Electrical Power Engineering | | |
| **Module** | Electrical Power Engineering | | |
| **Type and level of studies** | Master studies | | |
| **The name of the course** | Operation of Electric Power Networks | | |
| **Lecturer (for lectures)** | Korunović M. Lidija, Janjić D. Aleksandar | | |
| **Lecturer/associate (for exercises)** | Anastasijević B. Ivan | | |
| **Lecturer/associate (for OFE)** | | | |
| **Number of ECTS** | 5 | **Course status (obligatory/elective)** | Obligatory |

| | |
|---|---|
| **Prerequisites** | |
| **Course objectives** | Introducing the basic terms regarding operation of electric power networks to the students. Consideration of the parameters of daily load curves. Introducing the term of static state estimation and the way of identification of unknown state variables. Introducing the term of security and economic aspects of operation of electric power networks. Consideration of load variations during the year and daily load curve forecasting. Introducing the terms tariffs and tariff systems for calculations of purchase and sale of electricity, changes in distribution of electric energy, and models of energy market organization. |
| **Course outcomes** | Students are habilitated to perform state estimation of electric power systems and load flow calculation in different abnormal operating regimes of these networks. Additionally, they are habilitated to solve the problems of economic dispatch of electric power systems. |
| **Course outline** | |
| **Theoretical teaching** | Daily load curve. Static state estimation. Security of electric power networks. Operating regimes and security. Static security of electrical interconnections. Economic aspects of operation of electric power networks. Economic dispatch. Optimal power flow. Load variations during the year and daily load curve forecasting. Tariffs and tariff systems for calculations of purchase and sale of electricity. The changes in electricity distribution. Models of energy market organization. |
| **Practical teaching (exercises, OFE, study and research** | Exercises include solution of computational tasks in the areas of theoretical lectures. The tasks are illustrative examples for the solution of concrete problems that habilitate students to solve engineering problems individually. |
| **Textbooks/references** | |
| 1 | M. S. Ćalović, A. T. Sarić, Operation of Electric Power Systems (in Serbian), Beopres, Beograd, 1999. |
| 2 | M. S. Ćalović, A. T. Sarić, P. Č. Stefanov, Workbook with Solved Examples in Power System Operation (in Serbian), Faculty of Technical Sciences Čačak, Čačak, 2006. |
| 3 | M. S. Ćalović, A. T. Sarić, P. Č. Stefanov, Power System Operation in Deregulated Energy Market in the Conditions of Free Market (in Serbian), Faculty of Technical Sciences Čačak, Čačak, 2005. |
| 4 | D. P. Popović, Static Security of Electrical Interconnections (in Serbian), Electrical Engineering Institute Nikola Tesla, Belgrade, 2004. |
| 5 | A. Gomez-Exposito, A. J. Conejo, C. Canizares, Electric Energy Systems - Analysis and Operation, CRC Press, Taylor & Francis Group, Boca Raton, 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 | | |

| | |
|---|---|
| **Teaching methods** | Theoretical teaching includes classic lectures and the lectures in electronic form. Exercises include the solution of computational tasks on the board. |

**Grade (maximum number of points 100)**

| **Pre-exam duties** | **Points** | **Final exam** | **Points** |
|---|---|---|---|
| **Activity during lectures** | | **Written exam** | 25 |
| **Exercises** | | **Oral exam** | 25 |
| **Colloquia** | 50 | | |
| **Projects** | | | |

# Specification for the book of courses

| | | | |
|---|---|---|---|
| **Study program** | Electrical Power Engineering | | |
| **Module** | Electrical Power Engineering | | |
| **Type and level of studies** | Master studies | | |
| **The name of the course** | Control of Power Converters and Drives | | |
| **Lecturer (for lectures)** | Petronijević P. Milutin | | |
| **Lecturer/associate (for exercises)** | Filipović R. Filip | | |
| **Lecturer/associate (for OFE)** | Filipović R. Filip | | |
| **Number of ECTS** | 6 | **Course status (obligatory/elective)** | Obligatory |

| | |
|---|---|
| **Prerequisites** | None |
| **Course objectives** | Acquiring knowledge about modern control methods in power converters, adjustable spees drives, parameter calculation and settings and application of results on industry related equipments. Knowledge synthesis and its application in the AC and DC drives. |
| **Course outcomes** | Mastering the control methods of power converters and drives with application in industry. Students should be able to choose control methods based on drive performances and control requirements. Understanding of the basic control principle and analysis of sensor-less drives. |
| **Course outline** | |
| **Theoretical teaching** | Control oriented modelling of the basic electric drive components: control circuits, sensors, actuators, motors. Principle of operation, selection of control circuits and actuators. DC motor drives control. Basics, types and classification of Pulse Width Modulation (PWM). Space Vector Modulation. AC motor drives control: scalar, vector and direct torque control. PM motor control. Sensor-less control. Speed, torque and flux estimation. Control and optimization of converters in renewable energy sources. |
| **Practical teaching (exercises, OFE, study and research** | Numerical exercises: assigments in connection of theoretical teaching and laboratory exercises. Lab. exercises: Computer simulation and analysis of DC and AC drives. Analysis of vector controlled AC drive using Matlab. Experimental analysis of vector and DTC controlled drives. Analysis of sensorless motor drives. |
| **Textbooks/references** | |
| 1 | N. Mitrović, V. Kostić, M. Petronijević, B. Jeftenić: “Implementation of torque and flux control algorithms for induction motor drives”, Faculty of electronic Engineering, Niš, Serbia, 2009 (in Serbian). |
| 2 | S. N. Vukosavic, "Digital Control of Electrical Drives", Springer, 2007. |
| 3 | Vladan Vucković, Electric drives, Academic Mind, Belgrade, 2002 (in Serbian). |
| 4 | W. Shepherd, L. N. Hulley, D. T. W. Liang, Power Electronics and Motor Control, CRC Press, 2004 |
| 5 | |

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

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

| | |
|---|---|
| **Teaching methods** | Lectures with help of PowerPoint slides, animations and computer simulations. Theoretical lectures are illustrated with numerical exercises. First part of lab exercises is with computer simulation of drives and converters using Matlab/Simulink. Second part is practical workout with laboratory made converters for performance verification and testing of current (torque), speed and position controllers. |

**Grade (maximum number of points 100)**

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

# Specification for the book of courses

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

| | |
|---|---|
| **Prerequisites** | |
| **Course objectives** | Getting to know the process of work in the company in which the professional practice is carried out, its goals and organizational units. Getting to know the team and project to which a student is involved in his professional practice, which is in line with the elective area (module) that has been chosen by the student. Understanding the process of work in an enterprise, business processes, understanding of work risks, participation in design, documentation preparation or quality control, in accordance with the work process and the possibilities of the work environment. |
| **Course outcomes** | Improving students' ability to get involved in the work process upon completion of studies. Developing responsibility, professional approach to work and communication skills in the team. Complementing the theoretical knowledge acquired within the student's study program, and the practical application of studied issues. Using the experience of professionals working in an institution where the practice is carried out to expand practical knowledge and further motivate students to continue their studies and to work in the profession in the future. To gain a clear insight into the application of knowledge and skills acquired by the student in the study program. |
| **Course outline** | |
| **Theoretical teaching** | |
| **Practical teaching (exercises, OFE, study and research work)** | The content of the professional practice is in full compliance with the objectives of the practice. The student learns the structure of the company and the goals of its business, and the engagement in an enterprise is determined in accordance with the study area which has been chosen. The student duly fulfills the work obligations in accordance with the duties of the employees in the company. In the report from the completed professional practice, the student describes his engagement in the company and gives a critical overview of the knowledge and skills that he acquired during the practice. |
| **Textbooks/references** | |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

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

| Lectures | Exercises | OFE | Study and research work | Other classes |
|---|---|---|---|---|
| | | | | 6 |

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

**Grade (maximum number of points 100)**

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

# Specification for the book of courses

| | | | | |
|---|---|---|---|---|
| **Study program** | | | Electrical Power Engineering | |
| **Module** | | | Electrical Power Engineering | |
| **Type and level of studies** | | | Master studies | |
| **The name of the course** | | | Power Converters for Renewable Energy Sources | |
| **Lecturer (for lectures)** | | | Petronijević P. Milutin | |
| **Lecturer/associate (for exercises)** | | | Filipović R. Filip | |
| **Lecturer/associate (for OFE)** | | | | |
| **Number of ECTS** | | 5 | **Course status (obligatory/elective)** | Elective |
| **Prerequisites** | None | | | |
| **Course objectives** | Acquiring the basic knowledge and skills needed to design grid-side converters: selection of semiconductor and passive devices, design and realization of control circuits. | | | |
| **Course outcomes** | Providing relevant knowledge for analysing and designing grid-side converters used in renewable energy sources. Mastering the skills of using software tools for converters programming and components sizing. | | | |
| **Course outline** | | | | |
| **Theoretical teaching** | Control oriented modelling of converters: average model, linearization, detailed models. Pulse width modulation, Space vector PWM. Passive components sizing and selection, Acquisition of the Feedback Signals. Current Control: synchronous frame and proportional-resonant controllers. Voltages and power flow control. Synchronization of the grid-side converter. Disturbance Rejection | | | |
| **Practical teaching (exercises, OFE, study and research** | Numerical exercises: design of linear controllers; parameters calculation; examples of passive components sizing; controllers testing and performance verification. Student seminar work with practical exercises in laboratory. | | | |
| **Textbooks/references** | | | | |
| 1 | S. N. Vukosavic, "Grid-side converters design and control: Interfacing Between the AC Grid and Renewable Power Source", Springer, 2018 | | | |
| 2 | M. Kazmierkowski, R. Krishnan, F. Blaabjerg, "Control in Power Electronics: Selected Problems", Academic Press, 2002 | | | |
| 3 | Remus Teodorescu, Marco Liserre, Pedro Rodríguez, "Grid Converters for Photovoltaic and Wind Power Systems," Wiley, 2011. | | | |
| 4 | | | | |
| 5 | | | | |
| **Number of classes of active education per week during semester/trimester/year** | | | | |
| **Lectures** | **Exercises** | **OFE** | **Study and research work** | **Other classes** |
| 2 | 2 | 0 | | |
| **Teaching methods** | Numerical exercises: design of linear controllers; parameters calculation; examples of passive components sizing; controllers testing and performance verification. Student seminar works supported with practical exercises in laboratory. | | | |
| **Grade (maximum number of points 100)** | | | | |
| **Pre-exam duties** | | **Points** | **Final exam** | **Points** |
| **Activity during lectures** | | | **Written exam** | |
| **Exercises** | | | **Oral exam** | 40 |
| **Colloquia** | | | | |
| **Projects** | | 60 | | |

# Specification for the book of courses

| | | | |
|---|---|---|---|
| **Study program** | Electrical Power Engineering | | |
| **Module** | Electrical Power Engineering | | |
| **Type and level of studies** | Master studies | | |
| **The name of the course** | Power Systems Planning | | |
| **Lecturer (for lectures)** | Janjić D. Aleksandar | | |
| **Lecturer/associate (for exercises)** | Anastasijević B. Ivan | | |
| **Lecturer/associate (for OFE)** | | | |
| **Number of ECTS** 5 | **Course status (obligatory/elective)** | Elective | |
| **Prerequisites** | | | |
| **Course objectives** | Basic principles of electricity networks and system planning. Basic techniques of load forecast, development planning and optimization of electricity networks.<br>електроенергетских мрежа. | | |
| **Course outcomes** | Theoretical knowledge and practical knowledge. Students will be capable for developing the general development concept of different voltage level power systems . | | |
| **Course outline** | | | |
| **Theoretical teaching** | Definition and types of planning. Planning principles. Planning goals and objectives; optimization objectives and constraints.Load and generation forecast .Investment and operation costs of transmission lines. Calculation of energy losses. Engineering economy basics. Actualization principle. Uniform yearly equivalent. Amortization. Ranking of investments. Reliability of generation system and networks. Optimization techniques: linear programming, integer programing, dynamic programming, multicriteria optimization. | | |
| **Practical teaching (exercises, OFE, study and research** | General problems. Generation and load forecast. Planning and economy. Planning of new generation sources. Planning of transmission lines development. Distribution network planning. | | |
| **Textbooks/references** | | | |
| 1 | M. Calovic, A. Saric, M. Mesarovic, P. Stefanov. Planning of powers systems in deregulated environement (In Serbian)<br>Faculty of technical sciences, Cacak, 2011 | | |
| 2 | M. Calovic, A. Saric, M. Mesarovic, P. Stefanov. Planning of powers systems in deregulated environement - worked examples (In Serbian)<br>Faculty of technical sciences, Cacak, 2011 | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |

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

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

| | |
|---|---|
| **Teaching methods** | Oral lectures and calculation examples on board. Students are working autonomosly, with assistent supervision. Consultations. |

**Grade (maximum number of points 100)**

| **Pre-exam duties** | **Points** | **Final exam** | **Points** |
|---|---|---|---|
| **Activity during lectures** | 5 | **Written exam** | 30 |
| **Exercises** | | **Oral exam** | 20 |
| **Colloquia** | 30 | | |
| **Projects** | 15 | | |

# Specification for the book of courses

| | | | |
|---|---|---|---|
| **Study program** | Electrical Power Engineering | | |
| **Module** | Electrical Power Engineering | | |
| **Type and level of studies** | Master studies | | |
| **The name of the course** | Powerline Telecommunications | | |
| **Lecturer (for lectures)** | Nikolić B. Zorica, Milošević D. Nenad | | |
| **Lecturer/associate (for exercises)** | Milošević D. Nenad | | |
| **Lecturer/associate (for OFE)** | | | |
| **Number of ECTS** | 5 | **Course status (obligatory/elective)** | Elective |

| | |
|---|---|
| **Prerequisites** | |
| **Course** | Acquiring the basic knowledge related to the data transmission over power lines. |
| **Course outcomes** | Theoretical knowloedge. |
| **Course outline** | |
| **Theoretical teaching** | Introduction to Telecommunications. Signal Analysis. Methods for Signal Digitalization. Powerline Communications (PLC). PLC in the Telecommunications Access Area. Access Technologies. Powerline Communication Systems. Specific PLC Performance Problems. PLC Network Characteristics. Network Topology. Features of PLC Transmission Channel. Impact of Disturbances and Data Rate Limitation. Realization of PLC Access Systems. Architecture of the PLC Systems. Modulation Techniques for PLC Systems. Error Handling. PLC MAC Layer. Structure of the MAC Layer. Multiple Access Scheme. Traffic Control. Performance Evaluation of Reservation MAC Protocols. Reservation MAC Protocols for PLC. Signaling MAC Protocols. Protocol Comparison. |
| **Practical teaching (exercises, OFE, study and research** | Demonstrative laboratory exercises in the area of signal analysis and modulation. Preparation and presentation of a seminar paper within OFE. |
| **Textbooks/references** | |
| 1 | Halid Hrasnica, Abdelfatteh Haidine and Ralf Lehnert: Broadband Powerline Communications Networks-Network Design, John Wiley & Sons Ltd, 2004. |
| 2 | J. Anatory,N. Theethayi :Broadband Power-line Communication Systems, WIT Press, 2010. |
| 3 | |
| 4 | |
| 5 | |

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

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

| | |
|---|---|
| **Teaching methods** | Oral teaching in the classroom. Demonstrative laboratory exercises in the area of signal analysis and modulation. Preparation and presentation of a seminar paper within OFE. Consultation. |

**Grade (maximum number of points 100)**

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

# Specification for the book of courses

| | | | |
|---|---|---|---|
| **Study program** | Electrical Power Engineering | | |
| **Module** | Electrical Power Engineering | | |
| **Type and level of studies** | Master studies | | |
| **The name of the course** | Modelling of Electrical Machines and Drives | | |
| **Lecturer (for lectures)** | Mitrović N. Nebojša | | |
| **Lecturer/associate (for exercises)** | Kostić Z. Vojkan, Banković G. Bojan | | |
| **Lecturer/associate (for OFE)** | | | |
| **Number of ECTS** 5 | **Course status (obligatory/elective)** | Elective | |

| | |
|---|---|
| **Prerequisites** | |
| **Course objectives** | The objective of this course is to acquire knowledge about the dynamic modelling of asynchronous and synchronous drives under different conditions of power supply including power converter |
| **Course outcomes** | On completion of this course the student will be able to<br>• demonstrate knowledge and understanding of circuit modelling approach of electrical machines and basic transformations,<br>• analyse, design and implement complex electrical drives with different types of electrical machines,<br>• evaluate the applicability of electrical drives in different configurations and select the optimal control approach to fulfil the user requirements. |
| **Course outline** | |
| **Theoretical teaching** | Terms and definitions related to the dynamics of electric drives. Electrical drive as a dynamic system. Mathematical model. Simulation methods. Simulation software. Coordinate transformation. Mathematical models of synchronous and induction machines. Transformed models with linear characteristics of core magnetization. Model in current coordinates. Models in mixed coordinates. Model in flux coordinates. Examples of trajectories of motion. Start-up during direct connection to network. Reconnection of motor. Drive reversal. Cyclic load. Soft-start of an induction motor. Power converters model. Voltage source inverter. Current source inverter with pulse width modulation (PWM). Vector and direct torque control of induction and synchronous motor drives. Mathematical model of vector and direct torque control. Realization of the model. Vector control of permanent magnet synchronous machine. |
| **Practical teaching (exercises, OFE, study and research** | In laboratory experiments on real machines is implemented practical training which includes:<br>- Drive with induction and synchronous machines (verification of simulation models and analysis of working regime).<br>- The application of converters in AC drives. |
| **Textbooks/references** | |
| 1 | V. Vučković, ”Electrical drives”, Akademska misao,Beograd, 1997. (In Serbian) |
| 2 | Janusz Kacprzyk, "Advanced Control of Electrical Drives and Power Electronic Converters", Springer, 2017 |
| 3 | Piotr Wach,"Dynamics and Control of Electrical Drives", Springer, 2011 |
| 4 | Viktor M. Perelmuter, "Electrotechnical Systems Simulation with Simulink and SimPowerSystems", Taylor&Francis, 2013 |
| 5 | P. C., Krause, .., ”Analysis of Electric Machinery and Drive Systems”, Willey, 2013 |

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

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

| | |
|---|---|
| **Teaching methods** | In laboratory experiments on real machines is implemented practical training which includes:<br>- Drive with induction and synchronous machines (verification of simulation models and analysis of working regime).<br>- The application of converters in AC drives. |

**Grade (maximum number of points 100)**

| Pre-exam duties | Points | Final exam | Points |
|---|---|---|---|
| **Activity during lectures** | 5 | **Written exam** | 30 |
| **Exercises** | | **Oral exam** | 20 |
| **Colloquia** | 30 | | |
| **Projects** | 15 | | |

# Specification for the book of courses

| | | | | |
|---|---|---|---|---|
| **Study program** | | Electrical Power Engineering | | |
| **Module** | | Electrical Power Engineering | | |
| **Type and level of studies** | | Master studies | | |
| **The name of the course** | | Selected Chapters of Power Systems Analysis | | |
| **Lecturer (for lectures)** | | Tasić S. Dragan | | |
| **Lecturer/associate (for exercises)** | | | | |
| **Lecturer/associate (for OFE)** | | Stojanović S. Miodrag | | |
| **Number of ECTS** | 5 | **Course status (obligatory/elective)** | Elective | |
| **Prerequisites** | | | | |
| **Course objectives** | Objective of the course is that students learn the modern methods for calculating steady states and also disordered states in power systems. | | | |
| **Course outcomes** | After finishing this course, students should be able for solving and understanding complex phisical steady state and disordered state problems in power systems with an emphasis on computer applications. | | | |
| **Course outline** | | | | |
| **Theoretical teaching** | Power flow calculation for unbalanced load. Fuzzy approach for power flow calculation. Short-circuit current calculations. Fault current distribution. Time flow of short-circuit currents. Distribution of the aperiodic component of short-circuit current throughout the network. Simultaneous faults. Multimachine system models for stability analysis at large disturbances. Numerical methods for transient stability analysis. Voltage stability. | | | |
| **Practical teaching (exercises, OFE, study and research** | Laboratory exercises on computers in the field of: power flow, short-circuits and power system stability. | | | |
| **Textbooks/references** | | | | |
| 1 | D. Tasić, Power Systems and Networks Analysis, Press Series: Textbooks, Faculty of Electronic Engineering, Niš, 2010. (in Serbian) | | | |
| 2 | V. Stezoski, Basic calculations of power systems, Volume 1 and Volume 2, Faculty of Technical Sciences, Novi Sad, 2017. (in Serbian) | | | |
| 3 | N. Rajaković, Power System Analysis I, School of Electrical Engineering and Akademska Misao, Belgrade, 2002. (in Serbian) | | | |
| 4 | N. Rajaković, Power System Analysis II, Akademska Misao, Belgrade, 2007. (in Serbian) | | | |
| 5 | N. Tleis, Power Systems Modelling and Fault Analysis – Theory and Practice, Elsevier Ltd., 2008. | | | |
| **Number of classes of active education per week during semester/trimester/year** | | | | |
| **Lectures** | **Exercises** | **OFE** | **Study and research work** | **Other classes** |
| 2 | 0 | 2 | | |
| **Teaching methods** | Lectures, laboratory exercises, seminary work, consultations. | | | |
| **Grade (maximum number of points 100)** | | | | |
| **Pre-exam duties** | **Points** | **Final exam** | **Points** | |
| **Activity during lectures** | | **Written exam** | | |
| **Exercises** | 10 | **Oral exam** | 40 | |
| **Colloquia** | | | | |
| **Projects** | 50 | | | |

# Specification for the book of courses

| | | | |
|---|---|---|---|
| **Study program** | Electrical Power Engineering | | |
| **Module** | Electrical Power Engineering | | |
| **Type and level of studies** | Master studies | | |
| **The name of the course** | Special Electrical Instalations | | |
| **Lecturer (for lectures)** | Janjić D. Aleksandar | | |
| **Lecturer/associate (for exercises)** | Vučković D. Dragan | | |
| **Lecturer/associate (for OFE)** | | | |
| **Number of ECTS** 5 | **Course status (obligatory/elective)** | Elective | |
| **Prerequisites** | | | |
| **Course objectives** | The aim of the course is to familiarize students with the advanced techniques of electrical installation design and lighting of more complex and non-standard objects, installations with distributed power generation, the concept of "intelligent" buildings, as well as regulation about the impact of the distributed generation on the quality of power and lighting. | | |
| **Course outcomes** | Students will be trained to work on the project documentation and verification of implemented installations with distributed generation as well as "intelligent" building. Flood lighting of objects with different purposes and complexity, Design of electrical installations for outdoor lighting of roads and buildings. | | |
| **Course outline** | | | |
| **Theoretical teaching** | Autonomous sources of electrical energy. Static devices for uninterruptible power supply. Diesel-electric engines. Battery charger. Systems for uninterrupted supply . Solar generators - different ways of generating electricity, technical characterstics and types of solar panels and inverters. Wind turbines. Sizing elements of the hybrid power supply.<br>Electric light sources. Incandescent sources. Sources of electrical discharge. LED sources. Projecting light industrial space. Lighting of roads. Lighting of tunnels. Flood lighting. Lighting of sports facilities. Lighting installation in "intelligent" buildings. Regulations relating to the power quality. | | |
| **Practical teaching (exercises, OFE, study and research** | Solving the problems of the choice of the autonomous power system. Sizing of hybrid power systems. Sizing the system of industrial installations. Individual work on the road lighting design.<br>Research work consists of project design of a instalation of outdoor lighting, including some segment of industrial electrical instalation. | | |
| **Textbooks/references** | | | |
| 1 | M. Kostic „Lighting techniques guide“ (in serbian) Minel Schreder 2000 | | |
| 2 | Radaković, Z., Jovanović, M.: "Special electrical installations" (in serbian), Akademska misao, Beograd 208 | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |

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

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

| | |
|---|---|
| **Teaching methods** | Teaching and computational examples are performed by lecturing, on a board. Students are doing their works independently, with the assistant supervision. Consulations. |

**Grade (maximum number of points 100)**

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

# Specification for the book of courses

| | |
|---|---|
| **Study program** | Electrical Power Engineering |
| **Module** | Electrical Power Engineering |
| **Type and level of studies** | Master studies |
| **The name of the course** | Selected Topics in High Voltage Engineering |
| **Lecturer (for lectures)** | Javor L. Vesna |
| **Lecturer/associate (for exercises)** | Vučković D. Dragan |
| **Lecturer/associate (for OFE)** | |

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

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| **Prerequisites** | No |
| **Course objectives** | Study of high voltages, electrostatic discharges and methods for computation of electrostatic fields. Teaching students about protection against unwanted electrostatic discharges and applications of high voltage technique in different fields. |
| **Course outcomes** | Practical knowledge about complex methods for the computation of electromagnetic fields based on simple examples from electrostatics. Theoretical knowledge about processes of electrostatic discharges and practical applications of high voltage technique in various fields. Measures for protection against unwanted electrostatic discharges. |
| **Course outline** | |
| **Theoretical teaching** | Generating high voltages (HV), applications of HV and new technologies. Methods for solving electrostatic problems: analytic (Maxwell equations, method of images, direct solving the Laplace and Poison equations, method of separation of variables) and non-analytic (graphical method, finite difference method (FDM), method of moments (MoM), finite element method (FEM)). Electrostatic discharge (ESD), typical ESD voltages and sensitivity to ESD. Triboelectric series and triboelectric effect. Types of materials. Ohm's and hyperbolic theory. Relaxation time. Applications of HV: filters, xerography, laser printer, painting, varnishing, spraying, separation and transport of materials, testing and defect detection, surface treatment, smoke detector, defibrillator. Van de Graaff's, Marx' and Kelvin's generator. ESD models and currents according to the IEC 61000-4-2. ESD rules for flammable fluids and minimum ignition energy. Corona, brush, branched brush, conical discharge and spark. Measures of protection: grounding, ionization, antistatic preparation, humidity maintenance, increased conductivity, induction and additional measures according to the Rules on technical norms for protection against ESD. Monitoring, control, measurement equipment for ESD testing. |
| **Practical teaching (exercises, OFE, study and research** | Practical lectures are realized through computational exercises that cover the theoretical knowledge. |
| **Textbooks/references** | |
| 1 | Abdel-Salam M., "High-voltage engineering: theory and practice," Taylor&Francis, CRC Press, 2018. |
| 2 | Kuffel E., Zaengl W. S., Kuffel J., "High-voltage engineering: fundamentals," Newnes, 2000. |
| 3 | Arora R., Mosch W., "High-voltage and electrical insulation engineering," Wiley, 2011. |
| 4 | Ryan H. M.,"High-voltage engineering and testing," IET, 2013. |
| 5 | Veličković D., "Methods for electrostatic fields computation," (in Serbian), Stil, Podvis, Niš, 1982. |

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

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

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|---|---|
| **Teaching methods** | Lectures, exercises and consultations. |

**Grade (maximum number of points 100)**

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

# Specification for the book of courses

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|---|---|---|---|
| **Study program** | Electrical Power Engineering | | |
| **Module** | Electrical Power Engineering | | |
| **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 | |

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

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

| Lectures | Exercises | OFE | Study and research work | Other classes |
|---|---|---|---|---|
| | | | 12 | |

| | |
|---|---|
| **Teaching methods** | |

**Grade (maximum number of points 100)**

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

# Specification for the book of courses

| | | | |
|---|---|---|---|
| **Study program** | Electrical Power Engineering | | |
| **Module** | Electrical Power Engineering | | |
| **Type and level of studies** | Master studies | | |
| **The name of the course** | Master Thesis | | |
| **Lecturer (for lectures)** | | | |
| **Lecturer/associate (for exercises)** | | | |
| **Lecturer/associate (for OFE)** | | | |
| **Number of ECTS** 15 | **Course status (obligatory/elective)** | Obligatory | |
| **Prerequisites** | | | |
| **Course objectives** | The Master Thesis is aimed at consolidating, validating and practical application of acquired knowledge during Master Academic Studies. The opportunity is given to the student to demonstrate the ability to independently perform a project, which can be of the practical, research or theoretical-methodological character. The student also acquires experience in presenting his/her work in written form, and in presenting the results through oral presentation during the defence of the work. | | |
| **Course outcomes** | Ability to lead a standalone project, ability to formulate and analyse problems, critical awareness of possible solutions, and review of the literature from the given area. Application of acquired engineering, and design and problem solving skills, taking into account the complexity, cost, reliability and efficiency of the solution. Ability to write the work in a given form. Ability to clearly explain the completed project, which is demonstrated in the oral defence of work. | | |
| **Course outline** | | | |
| **Theoretical teaching** | Master Thesis is the independent research, practical or theoretical-methodological work of the student in accordance with the level of studies, in which he becomes acquainted with a narrow subject through literature review and adopts methodology of research, i.e. designing, necessary for completion of the thesis. By working on the thesis, the student applies the practical and theoretical knowledge acquired during the studies. The thesis, as a rule, contains an introductory chapter, a definition of the problem, an overview of the study area of the thesis and existing solutions, a proposal and a description of the solution, the conclusion and the references. A public oral defence of the thesis is organized in front of the commission of three members, one of which is a mentor of thesis. During the oral defence, the candidate explains the results of his/her work, and then answers the questions of the members of the commission, whereby the candidate proves the ability to oral presentation of the project. | | |
| **Practical teaching (exercises, OFE, study and research** | | | |
| **Textbooks/references** | | | |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |

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

| **Lectures** | **Exercises** | **OFE** | **Study and research work** | **Other classes** |
|---|---|---|---|---|
| | | | | |

| | |
|---|---|
| **Teaching methods** | |

**Grade (maximum number of points 100)**

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