

## Specification for the book of courses

<b>Study program</b>		Electrical Engineering and Computer Science		
<b>Module</b>		Control Systems		
<b>Type and level of studies</b>		Undergraduate Academic Studies		
<b>The name of the course</b>		Electrical Machines		
<b>Lecturer (for lectures)</b>		Mitrović N. Nebojša		
<b>Lecturer/associate (for exercises)</b>		Banković G. Bojan		
<b>Lecturer/associate (for OFE)</b>		Banković G. Bojan		
<b>Number of ECTS</b>	6	<b>Course status (obligatory/elective)</b>	Elective	
<b>Prerequisites</b>				
<b>Course objectives</b>	Acquisition of basic knowledge in the field of electrical machines. Understanding the principle of operation, construction and use of electrical machines. Analysis of steady states, mechanical and electromechanical characteristics.			
<b>Course outcomes</b>	Understanding the basic principles of electromechanical energy conversion. Understanding the basic characteristics and working methods of rotary machines. Ability to independently analyse and implement the procedure of commissioning in industrial environment.			
<b>Course outline</b>				
<b>Theoretical teaching</b>	Basic principles of electromechanical energy conversion. Electromechanical conversion devices. Construction: magnetic and electric circuit of electrical machines. Energy balance. Magnetic fields of electrical machines. Transformers. Construction: magnetic and electric circuit. The working principle. Equivalent scheme. Three-phase transformer. DC machines. DC generator. Divide according to the excitation. Equivalent scheme. Losses. Degree of efficiency. Characteristics of DC generators. DC motors. Electromotive force and torque. Mechanical characteristics depending on the mode of excitation. Commissioning. Control of DC motor by voltage and flux variations. Actuators for DC motor. Electromagnetic fields for AC machines. Three-phase induction machines. Construction. Divide according to the rotor construction. Realization of the rotating field. Motor and generator operation mode. Electromagnetic torque. Mechanical characteristics (torque - slip). Energy balance. Equivalent scheme. Speed control. Voltage and frequency variation. Static converters (AC/DC/AC). Single-phase induction motors. Synchronous machines. Construction. Principle of motor and generator operation. Electric motors. Characteristics of synchronous motors. Synchronous permanent magnet machines. Control characteristics and application of static converters.			
<b>Practical teaching (exercises, OFE, study and research)</b>	Practical exercise in the laboratory. Recognition of certain types of machines. Basic components and structures. Commissioning of certain types of machines. Mechanical characteristics of electrical machines.			
<b>Textbooks/references</b>				
1	S. Vukosavic, "Electrical Mmachines", Springer, 2013.			
2	Miloš Petrović "Electromechanical energy conversion" (In Serbian), Naučna knjiga, 1988			
3	A.E. Fitzgerald, Charles Kingley, Stephen Umans, "Electric Machinery", McGraw-Hill, 2003			
4	Austin Hughes, "Electric Motors and Drives Fundamentals, Types and Applications", Elsevier, 2006			
5	Ion Boldea, Lucian Tutelea, "Electric Machines Steady State, Transients, and Design with Matlab", Taylor&Francis, 2010.			
<b>Number of classes of active education per week during semester/trimester/year</b>				
<b>Lectures</b>	<b>Exercises</b>	<b>OFE</b>	<b>Study and research work</b>	<b>Other classes</b>
2	2	1	0	0
<b>Teaching methods</b>	Classes are conducted through lectures and exercises. Lectures use modern teaching methods. Auditory exercises with numerous example, refer students to independently solve problems from engineering practice. Part of the exercise is performed in the laboratory in order to obtain the steady state characteristics of electrical machines.			
<b>Grade (maximum number of points 100)</b>				
<b>Pre-exam duties</b>	<b>Points</b>	<b>Final exam</b>	<b>Points</b>	
<b>Activity during lectures</b>	5	<b>Written exam</b>	30	
<b>Exercises</b>	15	<b>Oral exam</b>	20	
<b>Colloquia</b>	30			
<b>Projects</b>				