

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., Oettinger 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				