

Specification for the book of courses

Study program		Electrical Engineering and Computer Science		
Module		Electron Devices and Microsystems		
Type and level of studies		Undergraduate Academic Studies		
The name of the course		Power Devices and Circuits		
Lecturer (for lectures)		Manić Đ. Ivica		
Lecturer/associate (for exercises)		Manić Đ. Ivica		
Lecturer/associate (for OFE)		Marjanović B. Miloš		
Number of ECTS		5	Course status (obligatory/elective)	Obligatory
Prerequisites				
Course objectives		To acquire basic knowledge on the structure, technology, principles of operation, characteristics and applications of specific power semiconductor devices and integrated circuits		
Course outcomes		Theoretical and practical knowledge for understanding of power device functions in the circuit and proper choice of power devices for given applications and reliable operation of electronic circuits		
Course outline				
Theoretical teaching		Introduction. Definition, types and applications of power devices. Carrier transport and lifetime. Semiconductor breakdown: avalanche breakdown, punch-through. techniques to minimize edge effects, thermal (secondary) breakdown. Power diodes: PIN diode, Schottky diode. Bipolar transistors: gain and breakdown voltage, high current density effects, safe operating area (SOA), switching characteristics, Darlington couple. Power thyristors: operation regimes, turning off the thyristor, thyristor types, triac, photothyristor. Static induction power devices: static induction transistor, static induction thyristor. MOS power devices: structure and principles of operation of LDMOS and VDMOS transistors, parasitic elements in VDMOS structure, electrical parameters, dynamic characteristics and SOA. MOS controlled thyristor (MCT). Insulated gate bipolar transistor (IGBT): structure and principles of operation, dynamic characteristics and SOA. Power electronic circuits: principles of integration, power modules and hybrid circuits, monolithic ICs, high-voltage ICs, smart power ICs and SOC (System-on-a-Chip), isolation techniques. Reliability of power devices: power device packages, heat dissipation, overload protection.		
Practical teaching (exercises, OFE, study and research work)		Auditory exercises cover the areas of breakdown voltage, power diodes, bipolar transistors, thyristors, power MOS transistors, IGBTs, power circuits and reliability of power devices. Laboratory exercises include: realization of current direction control circuits (H-bridge) with bipolar and VDMOS transistors, realization of VDMOS transistor circuits for time limited activation of the relays by means of push button, light pulse effect on photoresistor and touch sensor, realization of triac-based circuit for power supply voltage phase control, as well as realization of battery charger by means of voltage regulator circuit. In addition, open code microcontroller (Arduino) and power devices will be used for realization of the circuits aimed at regulating rotation speed and direction in DC motors, thyristor driving and control of light dimmer operation.		
Textbooks/references				
1	Printed matter – lecture texts and PowerPoint slides, problems with solutions and instructions for laboratory exercises			
2	S. Ristić, Discrete Semiconductor Devices, University of Niš, 1990, YU ISBN 86-7181-001-2 (in Serbian)			
3	V. Benda, J. Gowar, D.A. Grant, Power Semiconductor Devices – Theory and Applications, John Wiley & Sons, Chichester (UK), 1999, ISBN 0-471-97644-X			
4	B. Jayant Baliga, Fundamentals of Power Semiconductor Devices, Springer, New York, 2008, ISBN 978-0-387-47313-0			
5	Michael Margolis, Arduino Cookbook, O'Reilly, Sebastopol (CA), 2011, ISBN: 978-0-596-80247-9			
Number of classes of active education per week during semester/trimester/year				
Lectures	Exercises	OFE	Study and research work	Other classes
3	1	1	0	0
Teaching methods		Lectures, exercises, laboratory exercises, consultations		
Grade (maximum number of points 100)				
Pre-exam duties		Points	Final exam	Points
Activity during lectures		10	Written exam	25

Exercises	20	Oral exam	25
Colloquia	20		
Projects			