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AY 24

Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET University)

M.Tech. (First Semester – Regular/Supplementary) Examinations, January – 2026

24MPEPE11021– Power Semiconductor Devices and Modeling

(Power Electronics)

Time: 3 hrs | Maximum: 60 Marks

Answer ALL questions

(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions		CO #	Blooms Level
a.	Draw and label the static I–V characteristics of a power diode.	CO1	K1
b.	What is reverse recovery time in a power diode?	CO2	K1
c.	Draw the output characteristics of a power BJT and mark active, saturation and cut-off regions.	CO3	K1
d.	Draw the basic equivalent circuit of an IGBT.	CO4	K1
e.	Define soft recovery and hard recovery in diodes.	CO1	K2

PART – B **(10 x 5 = 50 Marks)**

Answer ***ALL*** the questions		Marks	CO #	Blooms Level
2. a.	Explain the turn-on and turn-off processes in a power diode, including charge storage and removal, with appropriate waveforms.	5	CO1	K4
b.	Describe reverse recovery phenomena in power diodes and analyze how it affects switching stresses and losses in associated devices.	5	CO1	K4
	(OR)			
c.	Discuss different types of power diodes (standard, fast recovery, Schottky) and compare their characteristics and applications.	5	CO1	K4
d.	Explain the design principles of diode snubber circuits and illustrate with at least two typical snubber configurations.	5	CO1	K4
3.a.	Explain the turn-on process of an SCR in detail, discussing gate triggering, current spreading and di/dt limitations.	5	CO2	K4
b.	Describe the turn-off mechanisms of SCRs (natural and forced commutation) and discuss dv/dt limitations with suitable waveforms.	5	CO2	K4
	(OR)			
c.	With neat diagrams, explain the switching characteristics of a GTO, highlighting differences from conventional SCRs.	5	CO2	K4
d.	Discuss overcurrent protection strategies for GTOs and explain how they are implemented in practical circuits.	5	CO2	K4
4.a.	Explain the structure and I–V characteristics of a power BJT and discuss its switching characteristics during turn-on and turn-off.	5	CO3	K4
b.	Describe the construction, static characteristics and switching behaviour of a power MOSFET under resistive load switching.	5	CO3	K4
	(OR)			
c.	Explain clamped inductive load switching of MOSFETs with appropriate waveforms and discuss associated stresses.	5	CO3	K4
d.	Analyze the effect of diode reverse recovery currents on switching losses and stresses in MOSFET-based converters.	5	CO3	K4

5.a.	Explain the structure, operating principle and static characteristics of an IGBT, comparing it with power MOSFETs and BJTs.	5	CO4	K4
b.	Describe in detail the switching characteristics of an IGBT under resistive and clamped inductive load, including turn-on and turn-off transients.	5	CO4	K4
	(OR)			
c.	Discuss the phenomenon of current tailing during IGBT turn-off, its causes and techniques to minimize its impact on losses.	5	CO4	K4
d.	Explain overcurrent and short-circuit protection methods for IGBTs in practical converter applications.	5	CO4	K4
6.a.	Develop a detailed electrical model of a power diode suitable for circuit simulation, including junction capacitance and reverse recovery behaviour.	5	CO1	K4
b.	Describe the basic structure, operation and V–I characteristics of a triac and list its typical applications in AC control.	5	CO2	K3
	(OR)			
c.	Discuss in detail dv/dt limitations of MOSFETs and methods used to limit dv/dt in practical circuits.	5	CO3	K4
d.	An IGBT operates with a constant collector current of 40 A and a saturation voltage of 2.2 V. If the device is on for 60% of the time at 10 kHz, compute the conduction loss.	5	CO4	K3

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