Reg.No.:												

VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN
[AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI]
Elayampalayam – 637 205, Tiruchengode, Namakkal Dt., Tamil Nadu.

Question Paper Code: 8014

B.E. / B.Tech. DEGREE END-SEMESTER EXAMINATIONS – MAY / JUNE 2024
Sixth Semester
Electrical and Electronics Engineering
U19EEV28 - POWER SWITCHING CONVERTERS
(Regulation 2019)

Time: Three Hours | Maximum: 100 Marks

Answer ALL the questions

Knowledge Levels (KL)	K1 – Remembering	K3 – Applying	K5 - Evaluating
	K2 – Understanding	K4 – Analyzing	K6 - Creating

PART – A

(10 x 2 = 20 Marks)

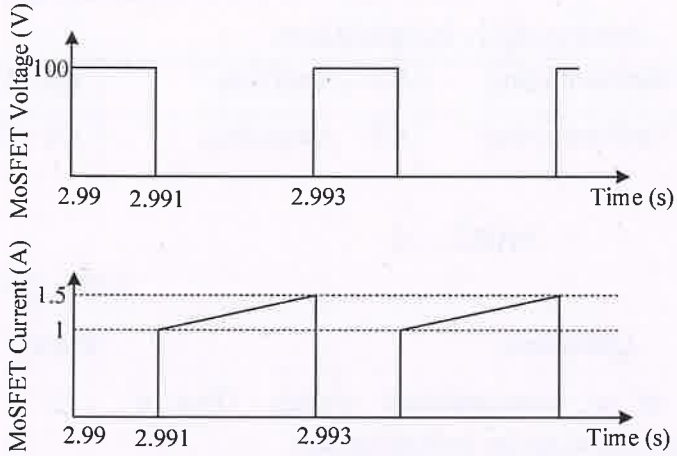
Q.No.	Questions	Marks	KL	CO
1.	Define switching loss of a semiconductor switch. Give a mathematical expression to calculate the switching loss.	2	K2	CO1
2.	Compare the basic principles of hard switching and soft switching techniques in power converters.	2	K3	CO1
3.	Draw schematic of a typical DC power supply used in electronic circuits.	2	K2	CO2
4.	Describe the operation principle of a switched-mode DC power supply with isolation.	2	K2	CO2
5.	In a single-phase synchronous rectification circuit, the input voltage is 230 V RMS and the output voltage is 12 V DC. If the efficiency of the converter is 90%, what is the input current (in A) when the load draws 2 A?	2	K4	CO3
6.	How does harmonic distortion affect the performance of power electronic systems?	2	K3	CO3
7.	Draw the schematic diagram of a flying capacitor multilevel inverter.	2	K2	CO4
8.	Calculate the modulation index and switching frequency required for a carrier-based PWM scheme applied to a five-level cascaded H-bridge inverter.	2	K4	CO4
9.	If a matrix converter has an input voltage of 230 V_{rms} and an output voltage of 380 V_{rms}, what is its voltage conversion ratio?	2	K3	CO5

10.		Describe the factors influencing the selection of modulation index in a matrix converter and its impact on output voltage quality and efficiency.	2	K2	CO5

PART – B

(5 x 13 = 65 Marks)

Q.No.			Questions	Marks	KL	CO
11.	a)	i.	Explain the switching characteristics (voltage, current and power) of a MoSFET.	6	K3	CO1
		ii.	For the following waveforms, calculate the power loss of the MoSFET. Let on-state resistance of the switch be 30 mΩ, $t_{on} + t_{off} = 60$ ns.	7	K5	



(OR)

	b)	i.	Define Zero Voltage Switching (ZVS) and Zero Current Switching (ZCS) techniques in power electronics.	5	K3	CO1
		ii.	Describe how these techniques are implemented in power converter circuits to minimize switching losses and improve efficiency. Explain the operation of boost converter using ZVS with necessary analytical waveforms.	8	K5	
12.	a)	i.	Discuss the importance of closed-loop control and regulation in DC power supplies. Explain how closed-loop control systems work to maintain output voltage stability and efficiency.	6	K4	CO2
		ii.	With a real-world example, explain the operation of a closed-loop regulation of a DC-DC converter for ensuring reliable power supply performance.	7	K5	

(OR)

	b)	i.	Provide examples of applications where multiple output power supplies are commonly used.	4	K3	CO2
		ii.	With a neat circuit diagram and analytical waveform, discuss the operation of a typical multiple output - single input with a multiple windings DC-DC converter.	9	K4	
13.	a)	i.	Explain the operation of a 230 V (rms), 50 Hz AC-DC converter with a load of 10 Ω.	6	K3	CO3
		ii.	Derive the expression of the input current and calculate the Total Harmonic Distortion (THD) of the input current if the converter operates at a switching frequency of 20 kHz and draws a maximum current of 8 A(rms). Assume the converter operates in Continuous Conduction Mode (CCM) and other necessary data for calculation.	7	K4	
			(OR)			
	b)	i.	Explain the operation of a single-phase boost PFC converter which is designed to operate from a 120 V (rms), 60 Hz, single-phase AC source. The output voltage of the converter is 400 V DC.	6	K2	CO3
		ii.	If the output power is 500 W, calculate: a. The required duty cycle for the boost converter. b. The value of the inductor in the boost converter. c. The peak current through the boost converter's switch assuming necessary data for calculation.	7	K5	
14.	a)	i.	Explain the operation of a cascaded H-bridge multilevel inverter with 2 H-bridge modules, each capable of generating 50 V.	8	K4	CO4
		ii.	Draw the analytical waveform for the above cascaded H-bridge multilevel inverter.	5	K4	
			(OR)			
	b)		Design a single-phase voltage source inverter to generate a 220 V (rms), 50 Hz output voltage with a modulation index of 0.8. Let the DC input voltage be 350 V.	13	K5	CO4
15.	a)	i.	Discuss the various topologies of AC-AC converters.	8	K2	CO5
		ii.	In a matrix converter with a DC link, if the DC voltage is 500 V and the output power is 15 kW, calculate a) the input power assuming an efficiency of 85% b) current delivered by the DC link	5	K5	
			(OR)			

b)	i.	Explain the basic topology of a matrix converter and how it differs from traditional converters.	6	K2	CO5
	ii.	Design a 3-phase matrix converter for an input voltage of 220 V and output voltage of 380 V. Assuming necessary data for the design.	7	K5	

PART – C

(1 x 15 = 15 Marks)

Q.No.		Questions	Marks	KL	CO
16.	a)	ABC Energy Solutions is a company specializing in renewable energy systems. They have been approached by a residential community in a remote area seeking to implement a solar photovoltaic (PV) system to meet their energy needs. The community is currently relying on diesel generators for electricity, resulting in high operational costs and environmental pollution. ABC Energy Solutions aims to design and install a sustainable solar PV system. Develop a comprehensive proposal outlining the design and implementation of a solar PV system integrated with efficient power conversion techniques for a standalone application. Let the load connected to the system be 230 V, 50 Hz, 5 kW. Assuming necessary data for the design.	15	K6	CO 2, 4
		(OR)			
	b)	XYZ Motors is a manufacturing company specializing in induction motor production. They are looking to upgrade their existing machinery to improve speed control mechanism. Design a suitable solid-state drive for a 50 kW induction motor for XYZ Motors. Provide recommendations for selecting appropriate motor drive configurations, and control strategies to meet the specific requirements of their industrial applications. Assuming necessary data for the design.	15	K6	CO 4