Reg. No.																

Question Paper Code	14716

B.E. - DEGREE EXAMINATIONS, APRIL / MAY 2026

Fifth Semester

Electrical and Electronics Engineering

20EEPC502 - POWER ELECTRONICS

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART – A (i) (MCQ)
(16 × 1 = 16 Marks)
Answer ALL Questions

		Marks	K – Level	CO
1.	Explain the behavior of a Silicon Controlled Rectifier when it operates in forward blocking mode. What prevents current conduction in this condition? a) Junction J 2 is in reverse bias and J 1 , J 3 is in forward bias. b) Junction J 3 is in forward bias and J 1 , J 2 is in reverse bias. c) Junction J 1, J 3 is in reverse bias and J 2 is in forward bias. d) Junction J 1 and J 2 is in forward bias and J 3 is in reverse bias	1	K2	CO1
2.	What is the purpose of the resistor used in a snubber circuit? a) To minimize the loss . b) To minimize the charging current. c) To minimize the discharging current. d) All of these.	1	K1	CO1
3.	Explain why certain power semiconductor devices are preferred for switching applications above 100 kHz. Which device is most suitable and why? a) BJT. b) Power MOSFET. c) Schottky diode. d) Microwave transistor.	1	K2	CO1
4.	Explain how two power converters with the same triggering angle and ratings may exhibit different performance. What factors influence their operation? a) a semi-converter operates at lower output voltage than a full converter b) a semi-converter operates at higher output voltage than a full converter c) a semi-converter has lower values of input p.f as compared to a full converter d) a semi-converter has more THD as compared to a full converter	1	K2	CO2
5.	A single-phase full controlled converted with RLE load will act like a line-commutated inverter when the firing angle α a) α >180° b) α >90° c) α <90° d) α = 90°	1	K3	CO2
6.	A single-phase semi-converter is connected to a 230 V source and is feeding a load R = 10 Ω in series with a large inductance that makes the load current ripple free. Find the average output current for α = 45° a) 14 A b) 17 A c) 10 A d) 0 A	1	K3	CO2
7.	In a buck boost converter circuit the value of duty cycle for boost operation must be a) k=0.5 b) k>0.5 c) k<0.5 d) k=1	1	K3	CO3
8.	A step down chopper is operated in the continuous conduction mode in steady state with a constant duty ratio D. If V0 is the magnitude of the dc output voltage and if is the magnitude of the dc input voltage, the ratio Vo/Vs is given by a) D b) 1-D c) 1/ 1-D d) D/ 1-D	1	K3	CO3

9.	A boost-regulator has an input voltage of 5V and the average output voltage of 15V. The duty cycle is a) 3/2 b) 2/3 c) 5/2 d) 15/2	*1*	*K3*	*CO3*
10.	The 180° mode operation of a three-phase inverter means: a) Each switch is on for 60° b) Each switch is on for 180° c) Each switch is on for 120° d) Each switch is off for 180°	*1*	*K3*	*CO4*
11.	What is a common difficulty in designing inverters for induction heating applications? a) Thermal management b) Voltage stability c) Frequency control d) Cost reduction	*1*	*K1*	*CO4*
12.	Which frequency range is typically used for switching in PWM inverters? a) 1 Hz to 10 Hz b) 1 kHz to 20 kHz c) 20 kHz to 50 kHz d) 50 kHz to 100 kHz	*1*	*K1*	*CO4*
13.	Which method is mainly used to improve power factor in AC voltage controllers? a) On-off control b) Phase control c) Amplitude control d) Frequency control	*1*	*K1*	*CO5*
14.	Explain how power flow is controlled in a Matrix Converter and describe the principle behind this control method. a) By adjusting input voltage b) By controlling the switching pattern of bi-directional switches c) By using transformers d) By varying the load	*1*	*K2*	*CO5*
15.	What is the main operating feature of a cycloconverter? a) Direct AC to DC conversion b) Frequency conversion without intermediate DC c) Only works with single-phase input d) Requires a transformer	*1*	*K1*	*CO5*
16.	Explain the operating principle of a single-phase AC voltage controller and describe its key functional feature. a) Requires three-phase input b) Uses two thyristors c) Provides direct current output d) Limited to resistive loads	*1*	*K2*	*CO5*

PART – A (ii) (Short Answer Questions)
(8 × 3 = 24 Marks)
Answer ALL Questions

17.	For a Silicon Controlled Rectifier, apply the concept of turn-off process to explain why the circuit turn-off time must be greater than the device turn-off time for successful commutation.	*3*	*K3*	*CO1*
18.	In a switching application, select a suitable Insulated Gate Bipolar Transistor type by comparing punch-through and non-punch-through structures based on their operating characteristics.	*3*	*K3*	*CO1*
19.	A two-pulse converter supplied from 230 V, 50 Hz with R = 10 Ω operates at different firing angles. Analyze how the average output voltage changes with firing angle and determine its value for $\alpha = 135°$.	*3*	*K4*	*CO2*
20.	Identify the operational advantages of a single-phase bridge converter compared to a single-phase mid-point converter.	*3*	*K3*	*CO2*
21.	A Boost Converter operates with a duty ratio of 0.6 and input voltage of 100 V. Apply the duty cycle relation to determine the output voltage for a load resistance of 5 Ω.	*3*	*K4*	*CO3*
22.	For a three-phase inverter, determine the switching patterns and operational differences between 120° mode and 180° mode conduction.	*3*	*K3*	*CO4*
23.	In inverter control applications, compare Space Vector Modulation (SVM) with traditional PWM techniques and explain why SVM provides improved performance.	*3*	*K3*	*CO4*

24.		Analyze the RMS and average output voltage expressions of a single-phase half-wave AC voltage controller and explain how these values vary with firing angle.	*3*	*K4*	*CO5*

PART - B (Descriptive Answer Questions)
(5 × 12 = 60 Marks)
Answer ALL Questions

25.	a)	For a given application, illustrate and explain the turn-on and turn-off switching behavior of an Insulated Gate Bipolar Transistor using suitable waveforms.	*12*	*K3*	*CO1*
		OR			
	b)	Draw and interpret the output characteristics of a Metal Oxide Semiconductor Field Effect Transistor and explain its operating regions based on the characteristics.	*12*	*K3*	*CO1*
26.	a)	Explain the operation of a single-phase fully controlled bridge converter with RL load in both rectifying and inversion modes. Illustrate the corresponding waveforms for load voltage and current.	*12*	*K3*	*CO2*
		OR			
	b)	Examine the operation of dual converter with neat circuit diagram and waveform.	*12*	*K3*	*CO2*
27.	a)	Analyze the operation of a buck converter with a neat waveform and derive the expression for peak-to-peak capacitor voltage ripple under different load conditions.	*12*	*K4*	*CO3*
		OR			
	b)	A step-down DC DC Chopper operates with input 230 V, load resistance 10 Ω, and chopper drop 2 V. For duty cycle 0.5, analyze the effect on output voltage and calculate average voltage and load power.	*12*	*K4*	*CO3*
28.	a)	Explain and apply the concept of output voltage control in a 120◦ mode three-phase inverter and describe the methods used for voltage regulation.	*12*	*K3*	*CO4*
		OR			
	b)	Analyse various types of PWM techniques in inverter.	*12*	*K3*	*CO4*
29.	a)	A single-phase AC voltage controller supplied from 230 V, 50 Hz feeds a resistive load of 15 Ω with a 6-cycle ON and 4-cycle OFF control pattern. Analyze and determine: (i) RMS output voltage (ii) Input power factor (iii) Average and RMS thyristor currents	*12*	*K4*	*CO5*
		OR			
	b)	Analyze the operation of a single-phase AC voltage regulator and explain how power factor control is achieved using appropriate circuit operation and waveforms.	*12*	*K4*	*CO5*