Reg. No.															

B.Tech. DEGREE EXAMINATION, MAY 2024

Fifth Semester

18EEC302J – POWER ELECTRONICS

(For the candidates admitted from the academic year 2018-2019 to 2021-2022)

Note:

(i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.

(ii) **Part - B & Part - C** should be answered in answer booklet.

Time: 3 hours | Max. Marks: 100

PART – A (20 × 1 = 20 Marks)

Answer **ALL** Questions

		Marks	BL	CO	PO
1.	For an SCR, $\frac{di}{dt}$ protection is achieved through the use of (A) R in series with SCR (B) RL in series with SCR (C) L in series with SCR (D) L across SCR	1	1	1	1
2.	The softness factor for soft-recovery and fast-recovery diodes are_____ respectively. (A) 1, >1 (B) <1, 1 (C) 1,1 (D) 1,<1	1	1	1	1
3.	A power MOSFET has three terminals called (A) Collector, emitter and base (B) Drain, source and base (C) Drain, source and gate (D) Collector, emitter and gate	1	1	1	1
4.	The GTO can be turned off (A) By a positive gate pulse (B) By a negative gate pulse (C) By a negative anode-cathode voltage (D) By removing the gate pulse	1	1	1	1
5.	In controlled rectifiers, the nature of load current, that is whether load current is continuous or discontinuous (A) Does not depend on type of load and firing angle delay (B) Depends both on the type of load and firing angle delay (C) Depends only on the type of load (D) Depends only on the firing angle delay	1	1	2	1
6.	In a single phase full converter with resistive load and for a firing angle α, the load current is zero and non-zero, respectively for (A) $\alpha, \pi - \alpha$ (B) $\pi - \alpha, \alpha$ (C) $\alpha, \pi + \alpha$ (D) α, π	1	2	2	1
7.	In a single-phase full converter, the number of SCRs conducting during overlap is (A) 1 (B) 2 (C) 3 (D) 4	1	2	2	1
8.	In a 3-phase full converter, the output voltage pulsates at a frequency equal to (A) Supply frequency, f (B) 2f (C) 3 f (D) 6f	1	2	2	1
9.	In DC choppers, if T_{on} is the on-period and f is the chopping frequency, then output voltage in terms of input voltage V_s is given by (A) $V_s.T_{on} / f$ (B) $V_s.f / T_{on}$ (C) $V_s / f.T_{on}$ (D) $V_s.f.T_{on}$	1	2	3	1

10. Parallel-capacitor commutation is 1 1 3 1
(A) Line commutation (B) Load commutation
(C) Forced commutation (D) External-pulse commutation

11. Buck-boost acts as buck converter for duty cycle is equal to 1 2 3 2
(A) 0.9 (B) 0.7
(C) 0.6 (D) 0.3

12. A SEPIC converter has V_s as the source voltage and α as the duty cycle. The output voltage is given by 1 2 3 1
(A) $V_s\alpha/(1-\alpha)$ (B) $V_s(1+\alpha)$
(C) $V_s/(1+\alpha)$ (D) $V_s\alpha$

13. In voltage source inverters, 1 1 4 1
(A) Load voltage waveform V_0 depends on load impedance Z, where as load current waveform i_0 does not depend on Z (B) Both V_0 and i_0 depend on Z
(C) V_0 does not depend on Z, where as i_0 depends on Z (D) Both V_0 and i_0 do not depend on Z

14. A single-phase full bridge inverter can operate in load commutation mode in case load consists of 1 2 4 1
(A) RL (B) RLC underdamped
(C) RLC overdamped (D) RLC critically damped

15. In sinusoidal-pulse modulation of inverter, amplitude and frequency for triangular carrier and sinusoidal reference signals are respectively 5V, 1kHz and 1V, 50 Hz. Find 1 2 4 2
(A) 0.2 (B) 0.9
(C) 0.8 (D) 1

16. In a current source inverter, if frequency of output voltage is fHz, then frequency of voltage input to inverter is 1 2 4 1
(A) f (B) 2f
(C) f/2 (D) 3f

17. The number of thyristors required for single-phase to single-phase cyclo converter of the mid-point type is 1 1 5 1
(A) 4 (B) 8
(C) 3 (D) 9

18. In the principle of phase control, 1 1 5 1
(A) The load is on for some cycles and off for some cycles (B) Control is achieved by adjusting the firing angle of the devices
(C) Control is achieved by adjusting the number of on off cycles (D) Control cannot be achieved

19. In the SMPS, regulation is accomplished by 1 1 6 1
(A) Duty cycle control (B) Regulator IC
(C) Zener diode (D) Stabilizer

20. Which currents are used for inducting heat in the high frequency induction furnace? 1 1 6 1
(A) Alternating primary currents (B) Direct primary currents
(C) Alternating secondary currents (D) Direct secondary currents

PART – B (5 × 4 = 20 Marks)

Answer **ANY FIVE** Questions

		Marks	BL	CO	PO
21.	The IGBT used in the circuit with supply voltage (V_{cc}) of 200 V and load resistance $R_L = 10\Omega$ has following data: duty ratio D=0.7, collector to emitter saturation voltage $V_{CE_{(sat)}}$ of 2 V, and switching frequency $f_s = 1kHz$. determine conduction power loss of IGBT.	4	2	1	2
22.	A single-phase semi controlled rectifier is employed in the AC to DC conversion with RL load. Compute average output voltage as a function of firing angle and maximum input AC voltage.	4	2	2	2
23.	Briefly explain the various control strategies in chopper circuit.	4	2	3	1
24.	A three phase bridge inverter is fed from a 600 V DC source. The Inverter is operated in 180° conduction mode and it is supplying a purely resistive star connected load. Determine (i) RMS value of the output line and phase voltages and (ii) Blocking voltage across power electronic switches	4	–	–	–
25.	Explain the role of power converters in PV systems and represent neat block diagram.	4	2	6	1
26.	Draw the block diagram of uninterruptable power supply (UPS) system. Compare the operation of short break and no break UPS.	4	2	6	1
27.	Explain the working principle of voltage commutated chopper with suitable circuit diagram.	4	2	3	1

PART – C (5 × 12 = 60 Marks)

Answer **ALL** Questions

		Marks	BL	CO	PO
28. a.	Explain the structure and detailed operation of three terminal power semiconductor device for AC voltage regulation with neat supporting diagram.	12	2	1	1
	(OR)				
b.	Explain the power MOSFET structure and its operation with static and dynamic characteristics.	12	2	1	1
29. a.	A single-phase full converter bridge is connected to RLE load. The source voltage is 230 V, 50 Hz. The average load current of 10 A is continuous over the working range. For $R = 0.4\Omega$, L=2mH, compute (i) Firing angle delay for E=120 V (ii) Firing angle delay for E= – 120 V Sketch the time variations of output voltage and load current for both the parts (i) and (ii).	12	2	2	2
	(OR)				
b.	A single phase full controlled converter is supplied to RL load with continuous load current. The thyristor firing angle is 0°. Compare the output voltage of converter without effect of source inductance and with effect of source inductance (where the overlap angle, μ = 44.17°). Given single phase supply voltage is 230 V, and frequency 50 Hz. Also construct circuit diagrams and draw model graphs of output voltages.	12	2	2	2

30. a.	The buck converter is employed in the application with following specifications. Input voltage 12 V, duty cycle 0.5, switching frequency 50 kHz, filter inductance and capacitance are 2 mH and 220μF respectively. With an average load current of 2 A, compute (i) average output voltage, (ii) Peak to peak ripple voltage and current and (iii)Load resistance and output power . Considering these parameters, sketch the circuit diagram and plot the necessary waveforms.	12	2	3	2
	(OR)				
b.	Design filter components for boost converter with the following specifications: Input voltage 24 V, output voltage 48 V. The peak to peak output ripple voltage is limited to 100 mV and peak to peak ripple current of inductor is limited to 0.5 A. The converter is operated with switching frequency of 100 kHz. Considering these parameters, sketch the circuit diagram and plot necessary waveforms.	12	2	3	2
31. a.	Explain the 120° mode operation of three-phase bridge voltage source inverter with representation of phase and line voltage RMS. Also, construct circuit diagram and provide voltage waveforms.	12	2	4	1
	(OR)				
b.	Explain the operation of single phase full bridge voltage source inverter with R, RL and RLC loads. Provide the analysis of load voltage and current waveforms with neat diagrams.	12	2	4	1
32. a.	A single-phase full wave AC voltage controller has input voltage of 220 V, 50 Hz and a load resistance $R = 20\Omega$. The firing angle of thyristor is $\frac{\pi}{2}$, determine (i) RMS output voltage (ii) Power delivered to load and (iii) Input power factor Also, construct circuit diagram and provide output voltage waveform analysis.	12	2	5	2
	(OR)				
b.	A single-phase AC voltage controller has input voltage of 200 V, 50 Hz and a load resistance R= 5Ω. For 5 cycles on and 5 cycles off, determine (i) RMS output voltage (ii) Power delivered to load and (iii) Input power factor Also construct circuit diagram and provide output voltage waveform analysis.	12	2	5	2

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