

Code: AE-26

Subject: POWER ELECTRONICS

JUNE 2007

Time: 3 Hours

Max. Marks: 100

NOTE: There are 9 Questions in all.

- Question 1 is compulsory and carries 20 marks. Answer to Q. 1. must be written in the space provided for it in the answer book supplied and nowhere else.
- Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.
- Any required data not explicitly given, may be suitably assumed and stated.

Q.1 Choose the correct or best alternative in the following: (2x10)

- a. A voltage V_{BB} is applied across a UJT. The emitter voltage at peak point is _____.
- (A) ηV_{BB} (B) $(\eta + 1)V_{BB}$
 (C) $(\eta V_{BB} + V_D)$ (D) V_D
- b. The stator voltage of an induction motor can be varied by
- (A) varying the rotor current.
 (B) changing the supply frequency.
 (C) pulse-width modulation inverters.
 (D) Rheostatic brake control.
- c. If 4 Quadrant operation is required, we need _____.
- (A) dual converter (B) full converter
 (C) semi converter (D) any of A, B, C
- d. If a step down chopper is fed by a dc voltage V and T_{ON} and T_{OFF} are on and off periods, then $V \left(\frac{T_{ON}}{T_{ON} + T_{OFF}} \right)$ is _____.
- (A) average output voltage (B) rms output voltage
 (C) neither (A) nor (B) (D) maximum output voltage
- e. In a single phase half wave ac regulator feeding a resistive load, the rms load current _____.
- (A) is always positive (B) is always negative
 (C) may be positive or negative (D) can be even zero
- f. An SCR can be turned off by _____.

- (A) reversing the anode voltage
- (B) reducing the anode current below the holding value
- (C) both (A) and (B)
- (D) none of A,B,C

g. For an SCR, the $\frac{dv}{dt}$ protection is achieved through the use of _____

- (A) R-L in series with the SCR
- (B) R-C in series with the SCR
- (C) R-C across the SCR
- (D) L in series with SCR

h. In a single phase full converter, for continuous conduction, each pair of SCRs conduct for _____.

- (A) $(\pi - \alpha)$
- (B) π
- (C) α
- (D) $(\alpha - \pi)$

i. A single phase bridge inverter delivers its output to a series connected RLC load with $R = 2\Omega$, $X_L = 8\Omega$. For this inverter, load commutation is possible in case the magnitude of X_C is _____.

- (A) 10Ω
- (B) 6Ω
- (C) 8Ω
- (D) zero

j. A phase controlled cycloconverter employs _____.

- (A) Line commutation
- (B) Load commutation
- (C) Forced commutation
- (D) No commutation

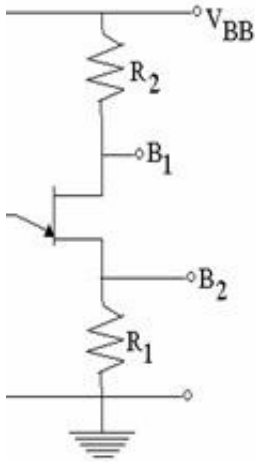
Answer any FIVE Questions out of EIGHT Questions.

Each question carries 16 marks.

Q.2 a. Define turn-off time period of an SCR; Discuss turn-off characteristics of an SCR with suitable waveforms for line commutated type. (2+6)

b. A relaxation oscillator using an UJT is to be designed for triggering an SCR. The UJT has $\eta = 0.75$, $V_P = 15V$, $V_V = 1V$, $R_{BB} = 4K\Omega$. Normal leakage current with emitter open = 4 mA, firing frequency is 2 KHz. For $C = 0.05\mu F$, compute the values of R, R_1, R_2 . (8)

Q.3 a. Draw the circuit diagram of a single-phase semi-converter with R-L load. Discuss its operation with waveforms. (3+6)



- b. A 3 phase half controlled bridge rectifier is feeding a R-L load. If the input voltage is $400 \sin 314 t$ and SCR is fired at $\alpha = \pi/4$, find the average load voltage. If any one supply line is disconnected, what is the average load voltage. (3+4)

Q.4 a. Explain the principle of operation of a step-up chopper with suitable circuit arrangement and current waveform. (8)

- b. A dc chopper has a resistive load of 20Ω and input voltage $V_s = 220V$. When the chopper is ON, its voltage drop is 1.5 V and chopping frequency is 10 KHz. If the duty cycle is 80%, find the average output voltage and the chopper on time. (4+4)

Q.5 a. With the aid of a circuit and waveforms, describe the working principle of resonant pulse commutation and obtain the expression for the circuit turn off time. (7+3)

- b. Differentiate between natural and forced commutation with examples. (3+3)

Q.6 a. How is power transfer realised in AC voltage controllers by on-off and phase angle control? Discuss with relevant circuits and waveforms. (5+5)

- b. A single phase voltage controller is used for controlling the power flow from a 220V, 50 Hz source into a load circuit consisting of $R = 4\Omega$, $WL = 6\Omega$. Calculate

- The control range of firing angle.
- Maximum value of rms load current. (3+3)

Q.7 a. Explain with the help of a circuit diagram and waveforms, the operation of a single-phase cyclo-converter using a center-tap transformer. (8)

- b. What is an inverter? Discuss the inverting operation of a single phase bridge inverter with suitable diagrams. (1+7)

Q.8 a. What is pulse width modulation control of inverters? Discuss the sinusoidal pulse width

modulation technique with gating signal
waveforms. (1+7)

- b. Differentiate between voltage source and current source induction motor drives for speed control.
(4+4)

Q.9 Write short notes on any **TWO** of the following:-

- (i) Chopper fed dc drive in power control.
- (ii) MOS-controlled thyristor.
- (iii) Single phase transformer tap changer.
- (iv) Buck regulator.

(8 × 2)