B.E. (ETC) Final Examination, 2012Part-IV 7th Semester

Sub: **Power Electronics**

(ET-701)

Full Marks – 70. Time – 3 Hrs.

Answer any five questions.

Answer should be brief and to the point.

Unnecessary lengthy answers may result in loss of marks.

1. a) Explain reverse recovery characteristics of power diode
   b) The reverse recovery time of of a diode is t_{rr} = 5 μs and the rate of fall of diode current is di/dt = 80 A/μs . If the softness factor is SF = 0.5, determine (i) the storage charge Q_{rr}, and (ii) the peak reverse current. (7+4+3)

2. a) Draw v-i characteristic of SCR and explain it. Draw two transistor equivalent circuit of Thyristor and explain how on state is achieved.
   b) How thyristor can be protected against di/dt and dv/dt triggering? (2+6+6)

3. The bipolar transistor in fig– 1. is specified to have β_F in the range of 10 to 40. The load resistance is R_c= 11Ω. The dc supply voltage is V_{cc} = 200 V and the input to the base circuit is V_B = 10 V. If $V_{CE(sat)}$ = 1.0 V and $V_{BE(sat)}$ = 1.5 V, find (a) the value of R_B that results in saturation with an ODF(Over Drive Factor) of 5 (b) β_{forced}, and (c) the power loss P_T in the transistor. Deduce any formula you use. (5+4+5)

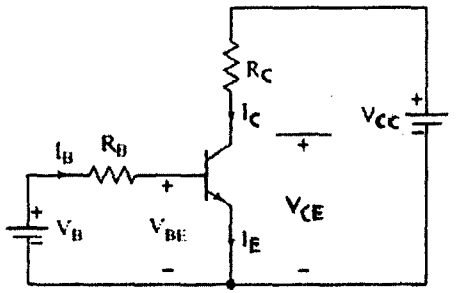

Fig – 1

4. Draw the schematic construction of a vertical MOSFET. Draw its parasitic model and explain its operation. (6+8)

5. (i) If the rectifier in Fig – 2 has a purely resistive load of R, determine (a) the efficiency, (b) the FF, (c) the RF, (d) the TUF.
(ii) Find the Fourier Series of the output voltage of the rectifier (8+ 6)

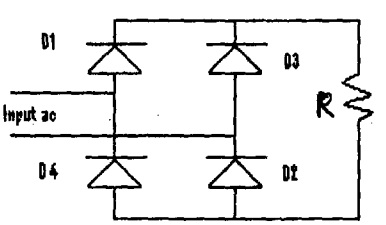

Fig – 2

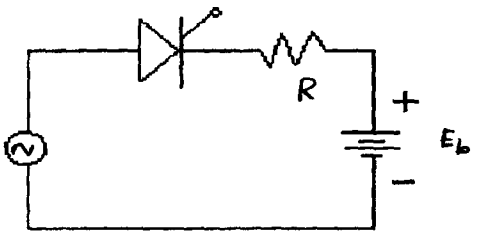

Fig - 3

6. (i) What are the problems of series connected diodes, and what are the possible solutions?
(ii) Two diodes are connected in series to share a total dc reverse voltage of V_D = 5 KV. The reverse leakage current of the two diodes are I_{s1} = 30 mA and I_{s2} = 35 mA. (a) Find the diode voltages if the voltages-sharing resistances are equal, R_1=R_2= R= 100 kΩ . (b) Find the voltages-sharing resistances R_1 and R_2 if the diode voltages are equal, V_{D1}=V_{D2}=V_D/2 (3+7 + 4)

7. (i) A DC battery is charged through a resistor R by a half wave thyristor controller as shown in the Fig -3. Derive an expression for the average value of charging current in terms of E_m, E_b, R etc. on the assumption that SCR is fired continuously and neglect drop across SCR.
(ii) Find conduction angles and show on the voltage & current wave forms, charging current for 230V, 50Hz AC input, R = 5Ω and E_b = 150V
(iii) Find the power supplied to the battery and that dissipated in the resistor.
(6+5+3)

8. (i) Dicuss the operation of a boost regulator with the help of neat circuit diagram and waveforms assuming load current is continous.
(ii) A boost regulator has an input voltage V_s = 6 V The average output voltage, V_a = 18 V and average load current, I_a = 0.4 A The switching frequency is 20 Khz. If L = 250 μH and C = 420 μF, determine (a) the duty cycle **k** (b) the ripple current of inductor, **ΔI**, (c) the peak current of inductor, $\mathbf{I_2}$ (d) the ripple voltage of capacitor, $\Delta \mathbf{V_c}$ and (e) the critical value of $\mathbf{L_c}$ and $\mathbf{C_c}$. (6+8)

9. Discuss UJT firing circuit with the help of a circuit diagram and its characteristics. An UJT oscillator circuit having following parameters: V_s = 30V, η = 0.51, I_p = 10μA, V_v = 3.5V, I_v = 10mA, R_{b1} = 100 ohm, R_{b2} = 654 ohm, R = 46.7 Ω, C = 0.5μF, width of pulse is t_g = 50mS, assume V_d = 0.5V(may be neglected if necessary). Find the operating frequency. How triggering circuit can be isolated from power circuit? (10+4)