CBCS SCHEME

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15EE53

Fifth Semester B.E. Degree Examination, Aug./Sept. 2020
Power Electronics

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. With neat circuit diagrams and waveforms, explain the operation of various types of power electronic circuits. **(08 Marks)**

b. With neat sketch, explain the reverse recovery characteristics. **(04 Marks)**

c. What are the peripheral effects of power electronic system? **(04 Marks)**

OR

2 a. Explain the function of a freewheeling diode, in a switched RL load circuit. Draw the circuit diagram and waveforms. **(07 Marks)**

b. Explain an ideal characteristic of switches. **(05 Marks)**

c. The reverse recovery time of a diode is trr = 3 μs and the rate of fall of the diode current is $\frac{di}{dt} = 30 \frac{A}{\mu s}$. Determine (i) the storage charge Q_{RR} and (ii) the peak reverse current I_{RR}. **(04 Marks)**

Module-2

3 a. With a neat sketch, explain the switching characteristics of POWER MOSFET. **(06 Marks)**

b. The bipolar transistor shown in Fig. Q3 (b) is specified to have β in the range of 8 to 40. The load resistance $R_C = 10\,\Omega$. The DC supply voltage is V_{CC} = 200 V and the input voltage to the base circuits is $V_B = 10$ V. If $V_{CE(sat)} = 1$ V, $V_{BE(sat)} = 1.5$ V.
Calculate (i) The value of R_B that result in saturation with an ODF of 5
(ii) Forced beta B_f
(iii) Power loss P_T of the BJT. **(06 Marks)**

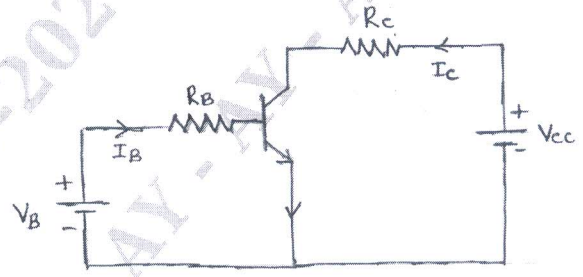

Fig. Q3 (b)

c. Write short note on Safe Operating Area (SOA) or switching limits of BJT. **(04 Marks)**

OR

4 a. Explain with necessary circuit diagram, any three of base drive control circuit for BJT. **(09 Marks)**

b. With neat sketch explain steady state (V-I) characteristics of n-channel IGBT. **(04 Marks)**

c. Discuss the needs and methods for providing isolation of gate/base circuits from power circuit with necessary circuit diagrams. **(03 Marks)**

Module-3

5 a. With neat sketch, explain the static V-I characteristics of an SCR. What are the significance of latching current, holding current and break over voltage. **(06 Marks)**

b. With the help of two transistor model derive an expression for the anode current of the thyristor. **(06 Marks)**

c. Mention and explain the various methods of turn-on used in thyristors. **(04 Marks)**

OR

6 a. How many SCRs are required in a series string to withstand a DC voltage of 3500 volts in steady state, if the SCRs have steady state voltage rating of 1000 V and steady state derating factor of 30%? Assuming maximum difference in leakage current of SCRs to be 10 mA. Calculate the value of voltage sharing resistance to be used. Draw the circuit showing the SCRs and the voltage sharing resistance. **(06 Marks)**

b. Write short note on $\frac{di}{dt}$ and $\frac{dv}{dt}$ protection of thyristor. **(04 Marks)**

c. With the help of circuit diagram and waveforms explain the UJT triggering to turn on the SCR. Write its necessary equations. **(06 Marks)**

Module-4

7 a. With the help of circuit diagram and waveforms, explain the working of single-phase full converter with highly inductive load. **(08 Marks)**

b. A single phase fully controlled bridge rectifier is fed from 230 V, 50 Hz supply. The load is highly inductive. Find the average load voltage and current if the load resistance is 10 Ω and firing angle is (α) 45°. **(08 Marks)**

OR

8 a. The single phase dual converter is operated from a 120 V, 60 Hz supply and the load resistance is R = 10 Ω. The circulating inductance is L_r = 40 mH; delay angles are $\alpha_1 = 60°$ and $\alpha_2 = 120°$, calculate the peak circulating current and the peak current of converter 1. **(08 Marks)**

b. With circuit diagram and relevant waveforms explain three phase full wave converter with inductive loads. Write its necessary equations. **(08 Marks)**

Module-5

9 a. With circuit diagram and quadrant operation, explain four quadrant choppers. **(07 Marks)**

A dc chopper shown in Fig. Q9 (b) has a resistive load of 10 Ω and the input voltage V_S = 200 V when the chopper switch is ON, its voltage drop is 2 V and the chipping frequency is 1 kHz. If the duty cycle is 50% determine (i) Average output voltage (ii) RMS output voltage (iii) The chopper efficiency (iv) The effective input resistance of the chopper. **(05 Marks)**

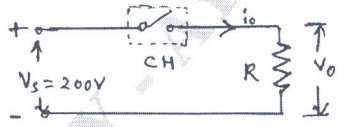

Fig. Q9 (b)

b. Mention the various performance parameters for the step-up and step-down choppers. **(04 Marks)**

OR

10 a. With relevant waveform explain sinusoidal pulse width modulation. **(04 Marks)**

b. The single phase full bridge inverter has a resistive load of R = 2.4 Ω and the DC input voltage of V_S = 48 volts. Determine (i) rms output voltage at the fundamental frequency (ii) The output power (iii) The peak and average current of each transistor. **(04 Marks)**

c. With the help of neat diagram and waveform explain the operation of 120° mode of 3-phase inverter with star connected R-load. **(08 Marks)**

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