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10EC73

Seventh Semester B.E. Degree Examination, June / July 2014
Power Electronics

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. With the help of a block diagram, explain the working of a converter system. Also explain how thyristor converters are classified. **(07 Marks)**

b. Give symbol, characteristic features of the following devices: i) GTO ii) TRIAC iii) MOSFET iv) DIAC. **(08 Marks)**

c. What are the peripheral effects caused by power electronic converters? What are the remedies for them? **(05 Marks)**

2 a. In the circuit of Fig. Q2 (a), the BJT is specified to have β in the range of 8 to 40. If V_{CC} = 200 V, R_C = 11 Ω, V_B = 10 V, $V_{CE(sat)}$ = 1 V and $V_{BE(sat)}$ = 1.5 V. Find (i) the value of R_B that results in saturation with an ODF of 5, (ii) the forced β_f and (iii) the power loss P_T in the transistor. **(09 Marks)**

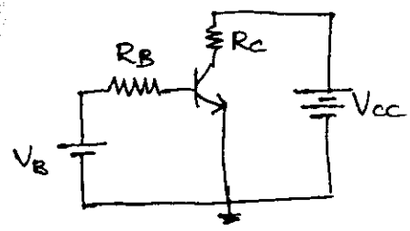

Fig. Q2 (a)

b. State and explain the output and transient characteristics of enhancement type MOSFET. **(08 Marks)**

c. Compare IGBT and MOSFET as switching devices. **(03 Marks)**

3 a. Explain the dynamic characteristics of SCR during turn on and turn off with suitable waveforms. **(08 Marks)**

b. In the thyristor circuit shown in Fig. Q3 (b), the SCR has a latching current of 50 mA and is fired by a pulse of length 50 μ sec. Show that without the resistor R, the thyristor will fail to remain on when the firing pulse ends and then find the maximum value of R to ensure firing. **(04 Marks)**

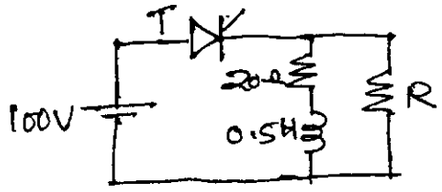

Fig. Q3 (b)

c. Explain the need for $\frac{dv}{dt}$ and $\frac{di}{dt}$ protection. A SCR circuit has the following data: Supply voltage = 200 V, $\frac{dv}{dt}$ rating = 100 V/μs, $\frac{di}{dt}$ rating = 50 A/μsec. Calculate the snubber circuit elements using approximate expressions. **(08 Marks)**

4 a. What will be the average power in the load for the halfwave controlled rectifier circuit shown in Fig. Q4 (a), when $\alpha = \frac{\pi}{4}$. Assume the SCR to be ideal. Supply voltage is $330\sin 314t$. Also calculate the RMS power and the rectification efficiency. **(10 Marks)**

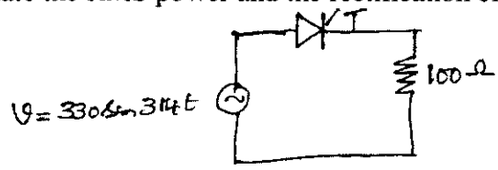

Fig. Q4 (a)

b. With the help of a neat circuit diagram and relevant waveforms, explain the working of a single phase dual converter with inductive load. **(10 Marks)**

PART – B

5 a. Calculate the conduction time of SCR and the peak SCR current that flows in the circuit shown in Fig. Q5 (a) employing self commutation if the supply voltage is 300 V, C = 1 μf, L = 5 mH and R_L = 100 Ω. Assume that the circuit is initially relaxed. **(08 Marks)**

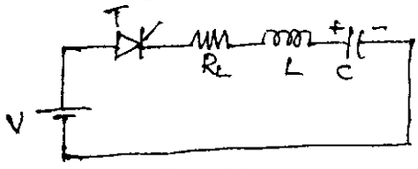

Fig. Q5 (a)

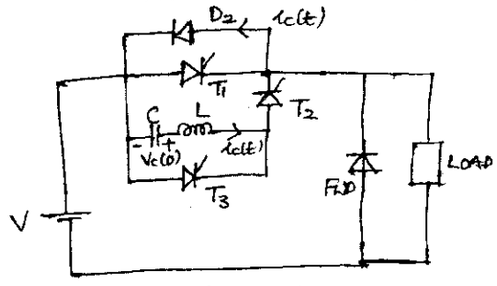

Fig. Q5 (b)

b. Fig. Q5 (b) shows a resonant pulse commutation circuit with the accelerating diode D_2 connected across the thyristor T_2. The initial capacitor voltage $V_C(0)$ = 200 V, C = 30 μf and L = 3 μH. Determine the circuit turn off time t_c, if the load current is I_L = 200 A. **(12 Marks)**

6 a. With the help of a neat circuit diagram and the relevant waveforms, explain the working of a single phase AC voltage controller with RL load. Derive an expression for the RMS output voltage. **(10 Marks)**

b. Find the RMS and average current flowing through the heater shown in Fig. Q6 (b). The delay angle of both the thyristors is 45°. **(10 Marks)**

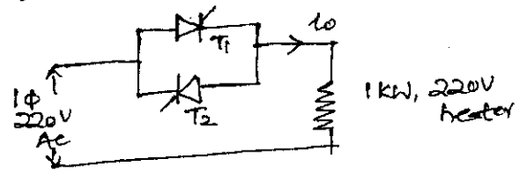

Fig. Q6 (b)

7 a. Derive an expression for the peak to peak ripple current ΔI for a stepdown chopper with RL load. **(10 Marks)**

b. What is a switching mode regulator? With the help of circuit diagrams and waveforms, explain the working of a Boost regulator with continuous current i_L. **(10 Marks)**

8 a. Explain the principle of operation of a single phase full bridge inverter with suitable circuit diagram and waveforms. **(10 Marks)**

b. Explain briefly the various voltage control techniques in single phase inverters. **(10 Marks)**

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