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10EC73

Seventh Semester B.E. Degree Examination, Dec.2017/Jan.2018
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. Mention at least one power semiconductor device for,
(i) Uncontrolled turn on and off.
(ii) Controlled turn on and uncontrolled turn off.
(iii) Controlled turn on and turn off.
(iv) Bi-directional control turn on and uncontrolled turn off. **(02 Marks)**

b. Write symbol and characteristics features of, (i) SCR (ii) MCT (iii) SITH (iv) MOSFET **(08 Marks)**

c. Explain different types of power electronics circuits with their input and output waveforms. **(10 Marks)**

2 a. Explain any three base drive control circuits of power BJT. **(10 Marks)**

b. Explain switching characteristics of IGBT. **(04 Marks)**

c. Discuss switching limits of power transistors. **(06 Marks)**

3 a. Explain different ways of thyristor turn-on methods and discuss turn on dynamic characteristics. **(10 Marks)**

b. Calculate the required parameters for snubber circuit to provide $\frac{dv}{dt}$ protection to a SCR used in a converter. The SCR has a maximum $\frac{dv}{dt}$ capability of 60 V/μsec. The input has a peak value of 425 volts and the source inductance is 0.2 mH. Given damping factor σ = 0.65. **(04 Marks)**

c. With neat circuit diagram and waveforms, explain RC-Halfwave firing circuit. **(06 Marks)**

4 a. Explain the operation of single-phase full converter with neat circuit diagram and waveforms for a ripple free and continuous load current. Derive the expression for average and rms output voltage. **(10 Marks)**

b. Explain how a dual converter works in all four quadrants. **(06 Marks)**

c. The single phase dual converter is operated from a 120 V, 60 Hz supply and delivers ripple free average current of I_{dc} = 20 A. The circulating inductance is L_r = 5mH and delay angles are $\alpha_1 = 30^\circ$ and $\alpha_2 = 150^\circ$. Calculate the peak circulating current and peak current of converter 1. **(04 Marks)**

PART – B

5 a. Explain the operation of an auxillary voltage commutation circuit using single auxillary thyristor. Derive an expression for commutating components. **(10 Marks)**

b. In the circuit shown in Fig. Q5 (b), the main SCR T_1 is to be turned off for atleast 140 μsec. For proper commutation determine the values of R and C. Given holding current of an auxillary SCR T_2 is 3.5 mA. **(04 Marks)**

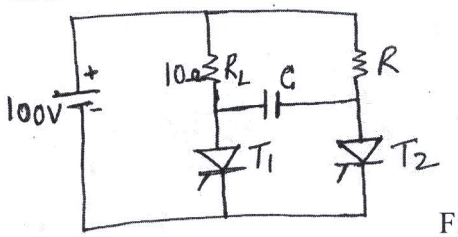

Fig. Q5 (b)

c. For the commutation circuit shown in Fig. Q5 (c). Check whether SCR is commutated successfully. If not what could be the minimum value of capacitor to be connected for successful commutation. Typical turn off time of SCR is 50 μsec. **(06 Marks)**

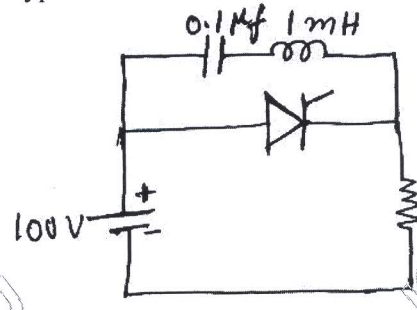

Fig. Q5 (c)

6 a. Explain the operation of single phase unidirectional AC-voltage controller with resistive load. Derive the expression for rms output voltage. **(10 Marks)**

b. Explain why a single short duration gating pulse is not suitable for inductive load. Also give the remedy for the same. **(06 Marks)**

c. The AC-voltage controller uses ON-OFF control for heating a resistive load of R = 4 Ω and input voltage is V_S = 230V , 50 Hz. If the desired output power P_0 = 3 kW. Determine (i) the duty cycle K and (ii) Input PF. **(04 Marks)**

7 a. Explain the performance parameters of choppers. **(04 Marks)**

b. Input to the step-up chopper is 200 V. The output required is 600 V. If the conducting time of thyristor is 200 μsec. Compute (i) Chopping frequency (ii) If pulse width is halved for constant frequency find the new output voltage. **(06 Marks)**

c. With the help of circuit diagram and waveforms, explain the working of a Buck regulator. Derive the expression for peak-to-peak ripple current of the inductors. **(10 Marks)**

8 a. Explain the operation of single-phase half bridge inverter with feedback diodes. Derive the expression for rms output voltage. **(10 Marks)**

b. With neat circuit diagram, explain thyristorized current source inverter. **(06 Marks)**

c. Compare between voltage source inverter and current source inverter. **(04 Marks)**

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