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10EE45

Fourth Semester B.E. Degree Examination, June/July 2015
Power Electronics

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. With a neat circuit and waveforms of control signal and output voltage, explain the control characteristics of IGBT and SCR. **(08 Marks)**

b. Explain briefly the different types of thyrister power converter and mention two applications of each and also specify the form of input and output waveforms. **(12 Marks)**

2 a. Sketch the structure of n-channel enhancement type MOSFET and explain its working principle. Also draw its transfer characteristics. **(07 Marks)**

b. Sketch and explain the switching characteristics of power BJT. The sketch should have the waveform i) V_{BE} ii) I_B and iii) I_C. **(06 Marks)**

c. The IGBT shown in the circuit of Fig.Q.2(c) has the following data:
t_{on} = 3μsec, t_{off} = 1.2μsec. Duty cycle D = 0.7, $V_{ce(sat)}$ = 2V, f_s = 1kHz. Determine:
i) Average load current.
ii) Conduction power loss.
iii) Switching power loss during turn-on and turn off. **(07 Marks)**

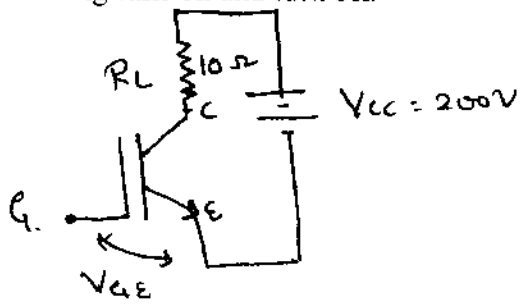

Fig.Q.2(c)

3 a. Using two transistor analogy, derive an expression for anode current of SCR. **(06 Marks)**

b. The SCR in Fig.Q.3(b) is used to control power in resistance R. The supply is 400V, and the maximum allowable di/dt and dv/dt the SCR are 50 A/μsec and 200 V/μsec respectively. Compute the values of the di/dt inductor and the snubber circuit components R_s and C_s. **(06 Marks)**

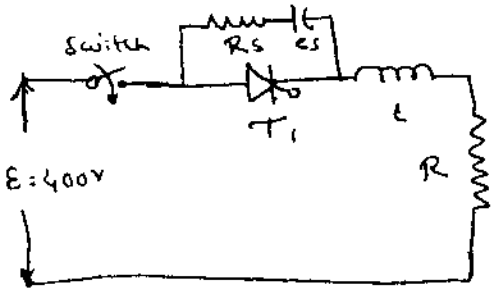

Fig.Q.3(b)

c. Mention and explain the various methods of turn-on used in thyristors. **(08 Marks)**

4 a. State the conditions to be satisfied for proper turn-off of SCR. **(02 Marks)**

b. With the help of circuit diagram and waveforms explain the operation of self commutation. **(08 Marks)**

c. In the Fig.Q.4(c) the source voltage $V_s = 100V$ and the current through R_1 and R_2 is 25A. The turn-off time of both the SCRS is 40 μsec. Find the value of capacitor for successful commutation and hence show that circuit turn off time is 0.693 RC. **(10 Marks)**

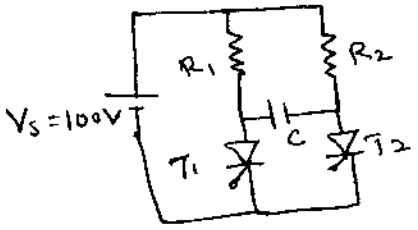

Fig.Q.4(c)

PART – B

5 a. With neat circuit and waveform derive an expression for the RMS value of output voltage of single phase semi converter with R.L. load (Assume discontinuous load current). **(06 Marks)**

b. A single phase half wave controlled rectifier is used to supply power to 10Ω load from 230V, 50Hz supply at a firing angle of 30°. Calculate: i) Average output voltage; ii) Effective output voltage; iii) Average load current. **(06 Marks)**

c. With neat circuit and waveforms explain the working principle of 3-ϕ half wave controlled rectifier with R load. **(08 Marks)**

6 a. What is a chopper? How are choppers classified? Give the quadrant of operation and one application of each type. **(08 Marks)**

b. With the help of a circuit schematic describe principle of step-up chopper. Obtain the expression for average output voltage in terms of duty ratio. **(06 Marks)**

c. A DC chopper has a resistive load of 20Ω and input voltage. $V_s = 220V$. When the chopper is on, its voltage drop is 1.5V and chopping frequency is 10kHz, if duty cycle is 80%. Determine the average output voltage, rms output voltage α chopper on time. **(06 Marks)**

7 a. With the help of neat diagram and waveform explain the operation of 180° mode of 3-ϕ inverter with star connected R-load. **(10 Marks)**

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

8 a. Distinguish between on-off control and phase control of AC voltage controller. **(04 Marks)**

b. Explain the operation of single phase bidirectional AC voltage controller for resistive load with the help of circuit diagram and waveforms. **(06 Marks)**

c. An AC voltage controller has a resistive load of R = 10Ω and rms input voltage is $V_s = 120V$, 60Hz. The thyristor switch is on for n = 25 cycles and off for m = 75 cycles. Determine:

i) The rms output voltage.

ii) Input power factor.

iii) Average and rms current of thyristors. **(10 Marks)**

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