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10EE45

Fourth Semester B.E. Degree Examination, June/July 2018

Power Electronics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. With a block diagram, explain the working of a power electronic converter with the help of a controller. **(06 Marks)**

b. Explain the control characteristics of (i) SCR (ii) GTO (iii) MCT (iv) MOSFET (v) SITH. Draw symbol, input, control signal and output waveforms for each device. **(10 Marks)**

c. With neat diagram, explain the working of thyristorized tap changers. **(04 Marks)**

2 a. Explain the need of base drive control with diagram. Explain proportional drive control of BJT. **(06 Marks)**

b. For the transistor switch of Fig.Q2(b), β varies between 8 and 40. Calculate:
i) The value of R_B that drives the device into saturation with ODF = 5
ii) Forced β_f
iii) Total power loss in the device.

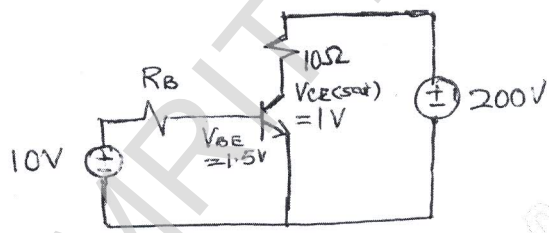

Fig.Q2(b) **(08 Marks)**

c. What is dv/dt and di/dt? Explain how to protect the device against dv/dt and di/dt. **(06 Marks)**

3 a. Why SCR is called as a semicontrolled device? Define latching current and holding current of a SCR. **(06 Marks)**

b. A SCR has a di/dt = 120 A/μs and du/dt = 300 V/μs. It operates on a dc voltage of 250 V. Calculate the value of components of protection circuit. **(06 Marks)**

c. Derive an expression for an equalizing resistance 'R' to be connected across each SCR of a series connected SCRs to share equal voltages under steady state conditions. **(08 Marks)**

4 a. What is commutation? Distinguish between natural commutation and forced commutation. **(06 Marks)**

b. With a neat diagram and waveform, explain the working of auxiliary voltage commutation. **(08 Marks)**

c. A complimentary commutation circuit operates from a dc source of 120 V and uses $R_1 = R_2 = 10\ \Omega$, commutating capacitor C = 10 μF. Calculate: (i) Circuit turn off time (ii) Peak thyristor current. **(06 Marks)**

PART – B

5 a. With a circuit diagram, explain the working of a 1-ϕ full converter with R-load. Derive an expression for average and rms output voltage. Draw waveforms showing output voltage, output current, current through SCR and diode. **(12 Marks)**

b. A 1-ϕ semiconverter is operated from 120V, 50Hz ac supply. The load resistance is 10Ω. If the average output voltage is 25% of the maximum possible average output voltage. Determine: (i) Firing angle (ii) rms and average output current (iii) rms and average thyristor current. **(08 Marks)**

6 a. Explain the principle of operation of step-up chopper with resistive load. Derive the expression for average output voltage. Draw relevant waveforms. **(07 Marks)**

b. Explain different control strategies used for choppers. Draw relevant waveforms. **(06 Marks)**

c. A chopper is operated on TRC at a frequency of 2 kHz. The supply voltage is 460 V and the load voltage is 350 V. Calculate the conduction and non conduction period of the thyristor in each cycle. **(07 Marks)**

7 a. With neat circuit, waveforms showing conduction intervals, sequence of device conduction and equivalent circuit, explain the working of 3-ϕ inverter for 180° conduction. Also show the line voltage V_{RY} and phase voltage V_{RN}. **(10 Marks)**

b. A 1-ϕ bridge inverter has a resistive load of 10Ω and the dc input voltage is V_s = 220 V. Calculate:
i) The rms output voltage at fundamental frequency
ii) The average, rms and peak currents of each thyristor
iii) The output power **(05 Marks)**

c. With neat circuit diagram, explain the working thyristorized current source inverter. **(05 Marks)**

8 a. With a neat diagram and relevant waveforms, explain the principle of operation of bidirectional controllers with RL load. Derive an expression for rms value of output voltage. **(08 Marks)**

b. In an ON-OFF control circuit using 1-ϕ, 230 V, 50 Hz supply the ON time is 10 cycles and OFF time is 4 cycles. Calculate the rms value of the output voltage. **(04 Marks)**

c. Explain the effects of power electronic converter and remedial measures adopted. **(08 Marks)**

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