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10EC73

Seventh Semester B.E. Degree Examination, Dec.2015/Jan.2016
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. Give symbol, characteristic features of the following devices: GTO, TRIAC, MOSFET, UJT, SCR **(10 Marks)**

b. Explain briefly the different types of thyristor power converters and mention two applications of each. **(10 Marks)**

2 a. With the necessary waveforms, explain the switching characteristics of a power transistor. **(08 Marks)**

b. Give the comparison between MOSFET and IGBT. **(06 Marks)**

c. The collector clamping circuit of Fig. Q2 (c) has $V_{CC} = 100$ V, $R_C = 1.5\ \Omega$, $V_{d_1} = 2.1$ V, $V_{d_2} = 0.9$ V, $V_{BE} = 0.7$ V, $V_B = 15$ V and $R_B = 2.5\ \Omega$ and $\beta = 16$. Calculate

i) the collector current without clamping.
ii) the collector-emitter clamping voltage V_{CE}.
iii) the collector current with clamping. **(06 Marks)**

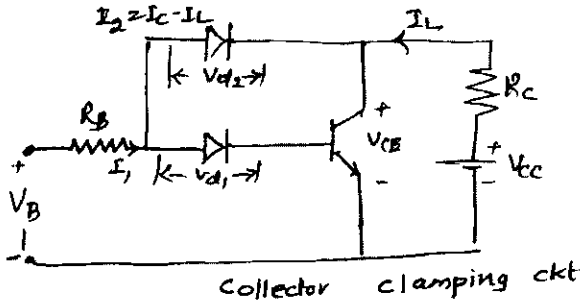

Fig. Q2 (c)

3 a. Define the following: i) latching current ii) holding current iii) I^2t rating
Derive expression for Anode current using two-transistor model in case of SCR. **(10 Marks)**

b. What is the need for protection of thyristor? Explain how thyristors are protected against high $\frac{di}{dt}$ and high $\frac{dv}{dt}$. **(06 Marks)**

c. A SCR has a $\frac{di}{dt} = 120$ A/μs and a $\frac{dv}{dt}$ of 300 V/μs. It operates on a 250 V DC source with a load resistance of 10 Ω. Find the suitable values for the components of the snubber circuit. **(04 Marks)**

4 a. Explain the working of single phase dual converter with neat circuit diagram. Draw relevant waveforms. **(10 Marks)**

b. Explain the working of single phase semiconvert with neat circuit and waveforms. Derive expression for the average output voltage. **(06 Marks)**

c. A single phase full converter supplies an RLE load from a 230 V, 50 Hz supply. The load is highly inductive, so that load current is continuous and ripple free. If R = 1 Ω and the load current is $I_0 = 10$A. Calculate the delay angle α for E = 120. **(04 Marks)**

PART – B

5 a. Explain the operation of a single phase bidirectional controller with resistive load. Obtain the expression for rms output voltage. Show the waveforms. **(10 Marks)**

b. A single phase full wave AC voltage controller has an RL load. The input voltage is 230 V, 50 Hz and the load is R = 2 Ω and $X_L = 2\,\Omega$, $\alpha_1 = \alpha_2 = \frac{\pi}{2}$. Calculate the following:

i) Angle until which the thyristor conducts.
ii) Conduction angle of thyristor.
iii) RMS voltage of output. **(06 Marks)**

c. What are the advantages and disadvantages of ON-OFF control and phase control of ac voltage controller? **(04 Marks)**

6 a. Explain the resonant pulse commutation with neat circuit and waveforms. **(10 Marks)**

b. Explain the working of complementary commutation circuit. Draw relevant waveforms. Derive expression for t_{off}. **(06 Marks)**

c. In the circuit of Fig. Q6 (c) the capacitor is initially charged to a voltage of $V_C(0) = -500$ V. If L = 15 μH and C = 50 μF and the SCR is turned ON at t = 0. Calculate (i) the peak value of resonant current and (ii) the conduction time of thyristor. **(04 Marks)**

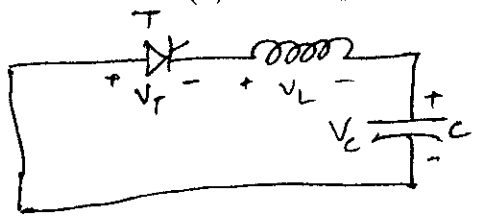

Fig. Q6 (c)

7 a. Give the classification of chopper. Explain briefly each one of them. **(10 Marks)**

b. Explain the principle of operation of a step up chopper. **(06 Marks)**

c. A dc chopper has an input voltage of 200 V and a load of 8 Ω resistance. The voltage drop across thyristor is 2 V and the chopper frequency is 800 Hz. The duty cycle K = 0.4. Find
i) Average output voltage
ii) RMS output voltage
iii) Chopper efficiency. **(04 Marks)**

8 a. Explain the performance parameters of inverters. **(06 Marks)**

b. Explain the working of transistorized current source inverter. **(08 Marks)**

c. Calculate the rms values of the fundamental and the two lower order harmonics of a single-phase full bridge inverter employing single-pulse width modulation for output voltage control. The modulation index is 80% and the dc input voltage is 230 V. **(06 Marks)**

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