

**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  $V_{CC} = 100\text{ V}$ ,  $R_C = 1.5\ \Omega$ ,  $V_{d_1} = 2.1\text{ V}$ ,  $V_{d_2} = 0.9\text{ V}$ ,  $V_{BE} = 0.7\text{ V}$ ,  $V_B = 15\text{ V}$  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)

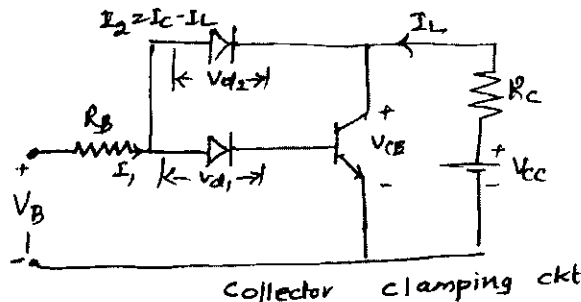


Fig. Q2 (c)

- 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  $\frac{di}{dt} = 120\text{ A}/\mu\text{s}$  and a  $\frac{dv}{dt}$  of  $300\text{ V}/\mu\text{s}$ . It operates on a  $250\text{ V}$  DC source with a load resistance of  $10\ \Omega$ . 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  $230\text{ V}$ ,  $50\text{ Hz}$  supply. The load is highly inductive, so that load current is continuous and ripple free. If  $R = 1\ \Omega$  and the load current is  $I_0 = 10\text{ A}$ . Calculate the delay angle  $\alpha$  for  $E = 120$ . (04 Marks)

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**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  $R = 2 \Omega$  and  $X_L = 2 \Omega$ ,  $\alpha_1 = \alpha_2 = \frac{\pi}{2}$ . Calculate the following:
- Angle until which the thyristor conducts.
  - Conduction angle of thyristor.
  - 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  $L = 15 \mu\text{H}$  and  $C = 50 \mu\text{F}$  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)

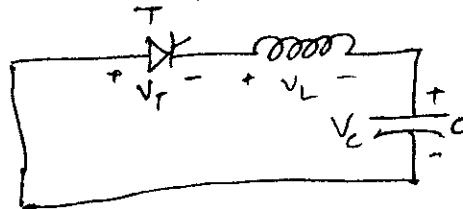


Fig. Q6 (c)

- 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  $8 \Omega$  resistance. The voltage drop across thyristor is 2 V and the chopper frequency is 800 Hz. The duty cycle  $K = 0.4$ . Find
- Average output voltage
  - RMS output voltage
  - 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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