

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 121603 Roll No.

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**B.Tech.**

**(SEM. VI) THEORY EXAMINATION 2013-14**

**POWER ELECTRONICS**

*Time : 3 Hours*

*Total Marks : 100*

**Note :- Attempt all questions.**

1. Attempt any four parts of the following : **(4×5=20)**
- (a) What are the characteristics of ideal power-switching devices ? Compare characteristics of MOSFET and IGBT.
  - (b) What are the primary and secondary breakdowns in semiconductor devices, differentiate between them ?
  - (c) Obtain the expression of input power factor for a single-phase half wave controlled rectifier feeding a purely resistive load.
  - (d) List specifications of power electronic switches.
  - (e) A dc supply of 100 V feeds a load resistance of 10 ohm and an inductance of 5 H through a thyristor. The latching current of thyristor is 50 mA. Find the minimum width of the gate pulse.
  - (f) The voltage and current ratings in a particular circuit are 5 kV and 100 A. Thyristors with ratings of 1000 V and 150 A are available. Minimum derating factor is 20%. Calculate the **number of series connected thyristors** required to handle the given source voltage and current.

2. Attempt any two parts of the following :  $(2 \times 10 = 20)$

- (a) What do you understand by chopper ? Describe the various types of chopper configurations with appropriate diagrams.
- (b) Discuss the two transistor model of a thyristor. Using this model, describe the various mechanisms of turning on a thyristor.
- (c) A complementary commutation circuit operates from a dc supply of 200 Volts and has resistance  $R_1 = R_2 = 10 \Omega$ , commutating capacitor  $C = 10 \mu\text{F}$ . Sketch the thyristor voltage waveform for one complete cycle of operation, when the two thyristors  $T_1$  and  $T_2$  in the circuit are triggered periodically one after the other. Calculate :
  - (i) Peak transient repetitive on state thyristor current that flows, at the instant of triggering the thyristor device
  - (ii) The circuit turn-off time.

3. Attempt any two parts of the following :  $(2 \times 10 = 20)$

- (a) Discuss the single phase dual converter under circulating current conduction mode of operation and derive the expression for inductor voltage.
- (b) Explain operation of single phase fully controlled bridge converter feeding a highly inductive load and draw its relevant output voltage and current waveforms.
- (c) A single phase full wave (bidirectional) ac voltage controller has resistive load  $R = 10 \Omega$  and the rms input voltage,  $V_i = 230 \text{ V}$ , 50 Hz. The thyristor switch is on for  $n = 25$  cycles and is off for  $m = 75$  cycles. Determine :
  - (i) the rms output voltage  $V_o$ .
  - (ii) the input power factor
  - (iii) the average and rms currents of thyristors.

4. Attempt any two parts of the following :  $(2 \times 10 = 20)$

- (a) Describe 1- $\phi$  ac voltage controller with resistive and inductive loads. Describe an expression for output voltage.
- (b) Discuss the principle of working of a single phase series inverter. What are the advantages and disadvantages of series inverters ?
- (c) A single phase full wave ac controller operates from 230 V, 50 Hz mains and feeds a resistive load whose value varies between 1.15 ohms and 2.30 ohms. Calculate :
  - (i) RMS current rating of each SCR
  - (ii) Average current rating of each SCR
  - (iii) The maximum load power for  $\alpha = \pi/4$ .

5. Attempt any two parts of the following :  $(2 \times 10 = 20)$

- (a) Describe the basic principle of working of 1- $\phi$  to 1- $\phi$  step-down Cycloconverter for both continuous and discontinuous conductions. Make the conduction of thyristor also.
- (b) What do you mean by VSI and CSI ? Describe with neat circuit diagram, single phase auto sequential commutated CSI.
- (c) For a single phase bridge inverter operating with a dc input voltage of 200 volts, calculate the amplitudes of the first three lower order harmonics in the voltage waveform.