

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

Paper ID :121502

Roll No.

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## B. TECH

(SEM. V) THEORY EXAMINATION, 2015-16

### POWER ELECTRONICS

Time:3 hours]

[MaximumMarks:100

#### Section-A

1. Attempt ALL the questions. (10x2=20)
  - (a) Discuss the techniques which result in random turn-on of a thyristor.
  - (b) A forward voltage is applied to an SCR soon after reverse recovery current drops nearly to zero value. Discuss, in brief, what would happen to SCR.
  - (c) A step down chopper switched at 1kHz with a duty ratio  $\alpha = 0.5$ . Find out the peak to peak ripple in load current.

- (d) A number of SCRs each with a rating of 2000V are to be used in series to handle 11kV. For a derating factor of 0.2, calculate the number of SCRs to be used in string.
- (e) Show the variation of converter output average voltage as a function of firing angle for (i) semi converter and (ii) full converter.
- (f) Discuss the advantages of using freewheeling diode in phase controlled rectifiers.
- (g) What is the disadvantage of using pulse gating scheme in ac voltage Controller when the load is RL?
- (h) What is a cyclo converter? Enumerate some of its industrial applications.
- (i) What is the purpose of connecting diodes in antiparallel with thyristors in inverter circuits?
- (j) What is a line commutated inverter?

**Section-B**

Note: Attempt ANY FIVE of the following. (5×10=50)

- Q2. (a) Explain the two transistor analogy of thyristor and derive the expression of anode current.
- (b) The SCR has  $V_g - I_g$  characteristics given as  $V_g = 1.5 + 8 I_g$ . In a certain configuration, the gate voltage consist of rectangular pulses of 12 V and of duration  $50 \mu S$  with duty cycle of 0.2.
- (i) Find the value of  $R_g$  series resistor in gate circuit to limit peak power dissipation in the gate circuit to 5W.
- (ii) Calculate the average power dissipation in the gate circuit.
- Q3. Why does unequal sharing takes place among series connected SCRs during steady state and dynamic state? Draw the static and dynamic equalizing circuits for two series connected SCRs.

Q4. Describe the principle of step up chopper. Derive an expression for the average output voltage in terms of input voltage and duty cycle. A step up chopper has output voltage of two to four times the input voltage. For a chopping frequency of 2000Hz, determine the range of off-periods for the gate signal.

Q5. A single phase semi converter connected to 230V, 50 Hz source is feeding a load  $R=10$  ohms in series with a large inductance that makes the load current ripple free. For a firing angle of 45 degree, calculate the output performance parameters of this converter.

Q6. Describe the working of a single phase fully controlled bridge converter in the rectifying and inversion mode, with the help of relevant waveform. Derive the expressions for average output voltage and rms output voltage.

Q7. Discuss the operation of a 1 -  $\phi$  ac voltage controller with RL load, when firing angle is less than or equal to load phase angle. Show that for firing angle less than load phase angle, output voltage of ac voltage controller cannot be regulated.

Q8. Discuss the neat circuit diagram of 3 -  $\phi$  to 1 -  $\phi$  cyclo converter feeding R-L load. Draw the output voltage waveforms.

Q9. Describe with neat circuit diagram and relevant waveforms, the working of a series inverter. Also indicate the merits and demerits of this inverter.

### Section-C

**Note: Attempt any two questions from this section.**

(15×2=30)

Q10. Discuss the effect of source inductance on the performance of a three phase full converter with the help of phase voltage waveforms. Indicate the sequence of conduction of various thyristors and sketch load current waveforms. Derive an expression for its output voltage in terms of supply voltage, source inductance, load current etc.

Q11. Describe with neat circuit diagram and relevant wave forms the working of three phase bridge inverter under 180° mode of conduction for a balanced star connected resistive load. Also state its merits and demerits over 120° mode.

Q12. Write short notes on:

- (a) Desired characteristics of a controllable switch.
- (b) Working of a class D chopper in first and fourth quadrant.
- (c) Integral cycle control in AC controllers.

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