

Sixth Semester Examination – 2007

POWER ELECTRONICS

Full Marks – 70

Time : 3 Hours

*Answer Question No. 1 which is compulsory and any five from the rest.*

*The figures in the right hand margin indicate full marks for the questions.*

1. Answer the following questions :  $2 \times 10$
- (i) What is natural or line commutation ?
  - (ii) What is the principle of phase control ?

P.T.O.

- (iii) What are the effects of removing the free-wheeling diode in single-phase semi-converters ?
- (iv) Why is the power factor of semi-converters better than full-converters ?
- (v) Why does the concept of saturation differ in BJT's and MOSFET's ?
- (vi) What are the effect of source inductance in a controlled rectifier ?
- (vii) In a three-phase full-converter, if load current is  $I$  and ripple free, then what is the average thyristor current ?

- (viii) A chopper has  $V_s$  as the source voltage,  $R$  as the load resistance and  $\alpha$  as the duty cycle. What is the rms value of output voltage ?
- (ix) A SCR has an anode supply of sine voltage 200 V rms, 50Hz applied through a  $100\Omega$  resistor and fired at an angle of  $60^\circ$ . Assuming no voltage drop, what is the rms value of the output voltage ?
- (x) Compare a SCR with a GTO.
2. (a) Enumerate the various mechanisms by which thyristors can be triggered into conduction. Discuss briefly the techniques which result in random turn-on. But the

other/others leading to reliable turn-on of thyristors should be discussed in detail.

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(b) Draw the characteristics of MOSFET and explain briefly. 4

3. (a) Snubber circuit for an SCR should primarily consist of capacitor only. But, in actual practice, a resistor is used in series with the capacitor – discuss. 5

(b) A thyristor is placed between a constant d.c. voltage source of 240 V and resistive load R. The specified limits for  $di/dt$  and  $dv/dt$  for the SCR are  $60 \text{ A}/\mu\text{s}$  and  $300 \text{ V}/\mu\text{s}$  respectively. Determine the values of the  $di/dt$  inductor and snubber circuit parameters.

Take damping ratio as 0.5. 5

4. A single-phase full-converter feeding RLE load has the following data. Source voltage = 230 V, 50 Hz;  $R = 2.5 \Omega$ ,  $E = 100 \text{ V}$ , firing angle =  $30^\circ$ .  
If load inductance is large enough to make the load current virtually constant, then

(a) Sketch the time variations of source voltage, source current, load voltage, load current, current through one SCR.

(b) Compute the average value of load voltage and load current.

(c) Compute the input p.f. 10

5. Explain the operation of a current commutated chopper with circuit diagram and associated voltage and current waveforms as a function of time. 10



6. Discuss the principle of working of a three-phase bridge inverter with an appropriate circuit diagram. Draw phase and line voltage waveforms on the assumption that each thyristor conducts for  $180^\circ$  and the resistive load is star-connected. The sequence of firing of various SCRs should also be indicated in the diagram. 10

7. Draw a modified series inverter circuit. Explain the operation with waveforms. Explain qualitatively how you can have output frequency higher than series resonance frequency. 10

8. Write notes on ; 2x5

(i) Class A Chopper

(ii) Effect of source inductance on the performance of controlled rectifier.