Total No. of printed pages = 5

CAI-504/PE/5th Sem/2014/N

POWER ELECTRONICS

Full Marks – 70

Pass Marks – 28

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer any *five* questions.

1. (a) What are the different modes of operation of thyristor ? Explain with the help of static V-I characteristics. 5

   (b) Justify the statement "Higher the gate current, lesser is the forward breakover voltage of thyristor". 3

   (c) Derive the expression of resistor R which should be connected for the static voltage equalization for series connected SCRs. 4

   (d) Calculate the intrinsic stand off ratio for an UJT with internal resistance $R_{B_1} = 3.5\ k\Omega$ and $R_{B_2} = 3\ k\Omega$. 2

[Turn over

2. (a) Explain the operation of Gate turn off thyristor. 4

(b) A string of three series connected thyristors is provided with static and dynamic equalizing circuits. The string has to withstand an off state voltage of 10 kV. The static equalizing resistance is 20 kΩ and the dynamic equalizing circuit has RC = 50Ω and C = 0·05μF. The leakage currents for three thyristors are 20 mA, 25 mA and 16 mA respectively. Determine voltage across each SCR in the off state and the discharge current of each capacitor at the time of turn on. 5

(c) Describe the method of forced commutation to turn off a thyristor. 5

3. (a) Obtain the expression of average, rms voltages and input power factor for a single phase half wave thyristor circuit with R-load. 8

(b) A 230V, 50 Hz, one pulse SCR controlled converter is triggered at a firing angle of 30° and the load current extinguishes at an angle of 200°. Find the circuit turn off time, average output voltage and the average load current for R = 5Ω, L = 2mH and E = 110V. 6

4. (a) Describe the operation of type-B chopper with the help of circuit diagram and output V-I characteristics. 5

(b) A d.c source voltage V_s = 220V is applied to a step down chopper whose load voltage R_L =10Ω. If the voltage drop across the chopper is 5V when it is on, calculate

(i) average and rms value of output voltage and

(ii) chopper efficiency if duty cycle $\alpha = 0{\cdot}5$. 6

(c) What are the control strategies that are used to vary the duty cycle ? Explain briefly about these strategies. 3

5. (a) Explain how a series inverter works ? Analyse the output current of series inverter circuit. 10

(b) In a self commutated SCR circuit, the load consists of R = 10Ω in series with commutating components of L = 10 mH and C = 10 μF. Check whether the circuit will commutate by itself when triggered from zero voltage condition on the capacitor. 4

6. (a) A 3 phase to single phase cycloconverter employs 3 pulse positive and negative group converts. Each converter is supplied from delta transformer with per phase turns ratio of 2:1. The supply voltage is 400V, 50 Hz. The RL load has R = 2Ω and at low output frequency W_oL = 1·5Ω. In order to account for commutation overlap and thyristor turn off time, the firing angle should not exceed 160°.

Calculate

(i) the fundamental rms output voltage

(ii) rms output current and

(iii) output power. 6

(b) Explain the working of no break UPS and solid state relay. 5+3=8

7. (a) What is base speed and back emf of a motor ? Describe how the speed of a d.c series motor can be controlled. 2+6=8

(b) Write short notes on any *two* of the following : (i)

$\frac{dv}{dt}$ triggering of thyristor

(ii) Step up cycloconverter

(iii) SCS. $2 \times 3 = 6$