B. Tech

CPEE 5306

Sixth Semester Examination – 2008

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 marks.

1. Answer the following questions : 2×10

    (i) What are the common techniques for voltage sharing of series connected thyristors ?

    (ii) What is the effect of reverse recovery time on the transient voltage sharing of parallel connected thyristors ?

(iii) What is the derating factor of series connected thyristors ?

(iv) Why a pulse train is used for gating thyristor ?

(v) A single-phase fully controlled bridge is supplied at 120 V. Determine the average voltage drop for firing angle of 30°, assuming each thyristor to have a volt-drop of 0.78 V.

(vi) In a 3-phase semiconverter, for a firing angle equal to 90° and for continuous conduction, what is the conduction period of the freewheeling diode ?

(vii) What are line commutated inverters ? How do they operate ?

(viii) What is the purpose of connecting diodes in antiparallel with thyristors in inverter circuits ?

(ix) Draw the circuit configuration of a chopper that is used for motoring only.

(x) A voltage commutated chopper has the following parameters :

$V_s = 200$ V, load circuit parameters : $1\,\Omega$, 2mH, 50V. Commutation circuit parameters : $L = 25\ \mu H$, $C = 50\ \mu F$. For constant load current at 100 A, what is the effective on period and peak current through the main thyristor ?

2. (a) Draw and explain the transfer and output characteristics of an IGBT.   5

(b) Discuss the turn-on and turn-off behaviour of an SCR.   5

3. · Discuss the effect of source-inductance on the performance of a single-phase fully-controlled converter, indicating clearly the conduction of various thyristors during one cycle. Derive the expression for its output voltage in terms of 10

   (i) maximum voltage Vm, firing angle α and overlap angle μ,

   (ii) Vm, α, Ls and Id. Show that the effect of source inductance is to present an equivalent resistance of $\omega Ls/\pi$ Ω in series with the internal rectifier voltage.

4. A three phase fully controlled bridge converter is supplying a dc load of 400 V, 60 A from a

three phase, 5Hz, 660 V (Line) supply. If the thyristors have a voltage drop of 1.2 V when conducting then, neglecting overlap, compute

   (i) the firing angle of thyristor,

   (ii) RMS current in thyristors,

   (iii) the mean power loss in thyristors.

   Draw the load voltage waveform. 10

5. (a) With an appropriate power diagram, discuss the principle of working of a three-phase bridge inverter. Draw phase and line voltage waveforms on the assumption that each thyristor conducts for 120° and the resistive load is star connected. 7

   (b) What is a current source inverter ? Give a comparison between voltage source inverter and current source inverter. 3

6. (a) Draw a neat diagram of parallel inverter employing feedback diodes. Explain the working of inverter with the help of voltage and current waveforms. What care should be taken to avoid commutation failure ?   6

(b) Give a detailed design aspects of series inverter.   4

7. (a) With the help of basic power circuit diagram explain the working of a current commutated chopper. Also, draw the associated waveforms.   5

(b) A current commutated chopper controls a battery powered electric car. The battery voltage is 100 V, starting current is 100 A, thyristor turn-off time is 20 μs, chopper

frequency is 400 Hz. Compute the values of commutating capacitor and commutating inductor. Take the ratio of peak commutating current to maximum possible load current as equal to 3.   5

8. Write short notes on :   5×2

(a) Overvoltage protection

(b) Brust Firing.

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