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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 ?

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- (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 : 1Ω , 2mH , 50V . Commutation circuit parameters : $L = 25 \mu\text{H}$, $C = 50 \mu\text{F}$. 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

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

(ii) V_m , α , L_s and I_d . Show that the effect of source inductance is to present an equivalent resistance of $\omega L_s / \pi \Omega$ 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.

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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.

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

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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 ?

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

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

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(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 μ s, 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.

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8. Write short notes on : 5x2

(a) Overvoltage protection

(b) Brust Firing.

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