ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2008

POWER ELECTRONICS

SEMESTER – 6

Time : 3 Hours] [Full Marks : 70

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) A single phase full converter supplying a very high inductive load can operate in

a) 4 quadrants b) 3 quadrants

c) 2 quadrants d) 1 quadrant, of $V - I$ plane. ☐

ii) A current controlled device is

a) MOSFET b) BJT

c) Capacitor d) Inductor. ☐

iii) The main reason for connecting a pulse transformer at the output stage of an SCR firing circuit is to

a) amplify power of the triggering pulse

b) provide electric isolation

c) reduce the turn-on time of the SCR

d) avoid spurious triggering of SCR due to noise. ☐

iv) In a 3-phase full converter, the output voltage pulsates at a frequency equal to

a) supply frequency, f b) $2f$

c) $3f$ d) $6f$. ☐

v) Each diode of a 3-phase half-wave diode rectifier conducts for

a) 60° b) 120°

c) 180° d) 90°. ☐

vi) The transformer used in a switched mode power supply is

a) Air core b) Iron core

c) Ferrite core d) All of these. ☐

vii) If the gate current of an SCR is increased, the forward breakdown voltage V_{FBR} will

a) increase b) decrease

c) not be effected d) infinite. ☐

viii) In a single phase full converter, if α & β are firing & extinction angles respectively, then the load current as

a) discontinuous if $(\beta - \alpha) < \pi$

b) discontinuous if $(\beta - \alpha) > \pi$

c) discontinuous if $(\beta - \alpha) = \pi$

d) continuous if $(\beta - \alpha) < \pi$. ☐

ix) Which of the following devices exhibits second breakdown phenomenon ?

a) SCR b) Power MOSFET

c) Power BJT d) GTO. ☐

x) SCR can be triggered by

a) positive feedback action

b) negative feedback action

c) both positive & negative feedback action

d) none of these. ☐

xi) Resonant converter controls the output power by

a) varying the switching frequency around resonating frequency

b) varying the on-time of the switch

c) controlling the power loss in the switch

d) none of these. ☐

xii) Reverse recovery current in a diode depends upon

a) forward field current

b) storage current

c) temperature

d) PIV. ☐

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Derive an equation for anode current of an SCR considering two-transistor analogy of SCR.

3. In a single phase semi-converter, connected to 100 V, 50 Hz supply, find the average & r.m.s values of the output voltage if the firing angle is 60°.

4. What is a current source inverter ? Mention its merits & demerits compared to voltage source inverter.

5. Explain briefly why maximum triggering angle available from a resistance triggering circuit is 90°.

6. Explain various triggering methods of an SCR.

GROUP – C

(Long Answer Type Questions)

Answer any *three* questions. 3 × 15 = 45

7. a) Why is a three phase bridge controlled rectifier called a six pulse converter ? Explain briefly with circuit diagram and output voltage waveform.

b) A three phase six pulse converter is operated from a 3-phase star connected 400 V, 50 Hz supply and with R load (R = 10 ohm).

It is required to obtain an average output voltage equal to 50% of the maximum possible output voltage of the rectifier.

Find out at this condition

i) the firing angle

ii) the average output voltage

iii) the average current of each thyristor

iv) PIV requirement of each thyristor.

c) Explain how the above mentioned converter can act as rectifier and inverter.

6 + 6 + 3

8. a) Explain with a neat circuit diagram the operation of a boost converter.

b) A boost converter has a supply voltage of 250 volts, while the output voltage is 500 V. If the period of converter is 100 μsec, determine the conduction of the switch.

If the period is reduced to one third for constant frequency operation, find the output voltage.

c) With a neat circuit diagram explain the operation of CuK converter.

d) State the advantages of CuK converter over Buck-Boost Converter.

4 + 4 + 4 + 3

9. a) How is the working of a full bridge single phase inverter different from that of half bridge circuit. Explain with the help of diagrams.

   b) Draw and explain the operation of a fly-back converter. How does it differ from forward converter ?

   c) Explain how zero voltage switching can be achieved in a series resonant converter. 5 + 6 + 4

10. a) Explain the operation of IGBT. State the advantages of IGBT.

    b) How are di/dt & dv/dt protections achieved in SCR ?

    c) Define turn-on & turn-off time of an SCR with the help of dynamic characteristics. 6 + 5 + 4

11. Write notes on any *three* of the following : 3 × 5

    a) Electronic ballast

    b) Induction heating

    c) UPS

    d) Active front end converter.

    e) Need for power electronics converter.

END