MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : EC-705D

POWER ELECTRONICS

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

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

i) In a thyristor, anode current is made up of

a) electrons only

b) holes only

c) electrons and holes

d) none of these.

ii) When a power BJT is compared to power MOSFET

a) BJT has lower switching losses but higher conduction losses

b) BJT has higher switching losses but lower conduction losses

c) BJT has lower switching losses and conduction losses

d) BJT has higher switching losses and conduction losses.

iii) A single phase full converter can operate in

a) 4 quadrants b) 3 quadrants

c) 2 quadrants d) 1 quadrant.

iv) For an *SCR*, di/dt protection is achieved through the use of

a) *R* in series with *SCR*

b) *RL* in series with *SCR*

c) *L* in series with *SCR*

d) *L* across *SCR*.

v) Chopper control of DC motor provides variations in

a) frequency b) current

c) input voltage d) all of these.

vi) Reverse recovery current in a diode depends upon

a) forward field current

b) storage current

c) temperature

d) PIV.

vii) An IGBT has three terminals called

a) collection, emitter and base

b) brain, source and base

c) drain, source and gate

d) collector, emitter and gate.

viii) The most efficient gate-triggering signal for SCR is

a) a steady DC level

b) a short duration pulse

c) a high-frequency pulse train

d) a low-frequency pulse train.

ix) 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 SCR

d) avoid spurious triggering of SCR due to noise.

x) Switched mode power supply (SMPS) is preferred over continuous types because SMPS

a) is suitable for both CAN and DC

b) is suitable for low power circuits

c) is suitable for high power circuits

d) provides low power loss.

xi) In voltage source inverters

a) load voltage waveform v_0 depends on load impedance Z, whereas load current waveform i_0 does not depend on Z

b) load voltage waveform v_0 and load current waveform i_0 depend on Z

c) load voltage waveform v_0 does not depend on load impedance Z, whereas load current waveform i_0 depend on Z

d) both v_0 and i_0 do not depend on Z.

xii) In a single phase full bridge VSI has inductor L as load. For a constant source voltage, the current through the inductor is

a) square wave b) triangular wave

c) sine wave d) pulse wave.

GROUP – B

(Short Answer Type Questions)

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

2. Draw and explain a boost DC-DC converter. Write the expression for output voltage. 3 + 2

3. A thyristor is used to feed a load resistance 8 ohms from a 230 V single phase supply. The ratings of thyristor are :

Repetitive peak current = 300A, (di/dt) max = 40 A/μ sec and (dv/dt) max = 150 V/μ sec. Design a snubber circuit for protection of thyristor.

4. What is commutation ? Explain current commutation and voltage commutation. 2 + 3

5. "SCR is self latching device." Explain the statement with the help of two transistor analogy of SCR.

6. Write a short note on TRIAC.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Describe the construction of IGBT.

b) Explain its operation with the help of an equivalent circuit. State the advantages of IGBT.

c) How di/dt and dv/dt protections are achieved in SCR ?

d) Draw and explain non-isolated base drive circuit for BJT. 2 + 4 + 6 + 3

8. 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 *RL* 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

9. a) Describe with the help of necessary voltage waveforms and circuit diagram, the operation of a three phase voltage source inverter with 180° conduction mode delivering power to star connected pure resistive load.

b) A single phase half-wave inverter feeds a resistive load *RL* = 10 Ω . Source voltage is 240V DC. Determine the r.m.s. voltage, output power and r.m.s. value of current. 10 + 5

10. a) Discuss any scheme of microprocessor based triggering angle control.

b) Write a note on resonant converter. 7 + 8

11. Write short 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.