ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009

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) 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. ☐

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

a) 60° b) 120°

c) 180° d) 90°. ☐

iii) In a controlled rectifier, a freewheeling diode is necessary if the load is

a) inductive b) resistive

c) capacitive d) any of these. ☐

iv) It is possible to connect two or more MOSFETs in parallel because

a) the threshold value of the gate to source voltage is only 2-3 V

b) fast switching times are obtainable with it

c) the MOSFET has a verey small power loss under high frequency conditions

d) the MOSFET resistance has a positive temperature coefficient. ☐

v) The turn off loss in a GTO is ..... that of an SCR.

a) smaller than b) greater than

c) of the same order as d) double. ☐

vi) A three phase controlled rectifier feeds a purely resistive load. The data are V_s = 240 V (RMS) and R = 24 Ω . If the firing angle, α is 90°, then the average current delivered to the load is

a) 8·5 A b) 9·65 A

c) 3·38 A d) 6·75 A. ☐

vii) In a single phase voltage source bridge inverter, the shape of the load current depends on the

a) source voltage

b) duration of conduction of SCRs

c) load impedance

d) duration of conduction of the feedback diodes. ☐

viii) In a voltage source inverter, the purpose of the diodes across the SCRs is to

a) help the commutation of the SCRs

b) see that excessive current does not pass through the SCRs

c) protect SCRs from excessive voltages

d) feed the energy back from the load to the source under negative power conditions. ☐

ix) The condition suitable for the inverting mode of operation of a single phase bridge rectifier is

a) α greater than 90°

b) an extra inductance in series with a d.c. motor load, with $\alpha > 120°$

c) a battery in series with a d.c. motor, with α in the range $90° < \alpha < 120°$

d) a battery and an extra inductance in series with load, with $\alpha > 120°$.

☐

x) RC snubber circuit is used to protect an SCR against

a) false triggering b) failure to turn on

c) switching transients d) failure to commute. [ ]

xi) A 1 – ϕ full bridge inverter can operate in load commutation mode in case load consists of

a) RLC overdamped b) RLC underdamped

c) RLC critically damped d) all of these. [ ]

xii) The inverter circuit used in a UPS, the value of percentage total harmonic distortion should be

a) < 5% b) < 10%

c) < 15% d) < 2%. [ ]

GROUP – B

(Short Answer Type Questions)

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

2. Draw and explain dynamic switching characteristics of BJT.

3. 'SCR is self latching device.' Explain the statement with the help of two transistor analogy of SCR.

4. Explain with necessary waveforms, the principle of operation of an RC triggering circuit.

5. What are the advantages of zero-current and zero voltage converters over conventional D.C. to D.C. converters. State the concept of quasi-resonant converter. 3 + 2

6. A single phase halfwave inverter feeds a resistive load R_L = 10 Ω . Source voltage is 240 V D.C. Determine the r.m.s. voltage, output power and r.m.s. value of current.

GROUP – C

(Long Answer Type Questions)

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

7. a) Why is a three phase bridge full wave controlled rectifier called a six-pulse converter ? Explain with circuit diagram and output waveforms.

   b) A three-phase, six-pulse converter is operated from a 3-phase star connected 400 V, 50 Hz supply and with resistive load of 10 Ω. Load inductance is negligible. It is required to obtain an average output voltage equal to 50% of the maximum possible output voltage of the rectifier.

   Find at this condition,

   i) firing angle

   ii) the average output voltage

   iii) the average current of each SCR

   iv) PIV requirement of each SCR

   v) rectification efficiency. 5 + 10

8. a) Explain with a neat circuit diagram, the operation of a Buck-brost converter.

   b) A step-down chopper feeds a D.C. motor load. The data pertaining to this chopper based drive are E = 210 V, R_a = 7 Ω, L (including armature inductance) = 12 mH. Chopper frequency = 1·5 kHz, duty cycle = 0·55 and E_b = 55 V. Assuming continuous conduction, determine

   i) the average load current

   ii) current ripple

   iii) RMS value of current through chopper. 5 + 10

9. a) Describe with the help of necessary voltage waveforms and circuit diagram, the operation of a three phase voltage source inverter with 120° conduction mode delivering power to star connected pure resistive load.

   b) Explain how the output voltage of a single phase inverter is controlled by sinusoidal PWM. 10 + 5

10. a) With the help of block diagram, explain the principle of operation of UPS.

b) Write note on resonant converter. 7 + 8

11. a) With the help of suitable circuit diagrams, explain the principle of a flyback converter.

b) Discuss any scheme of microprocessor based trigging angle control. 7 + 8

END