ENGINEERING & MANAGEMENT EXAMINATIONS, DECEMBER – 2007

POWER ELECTRONICS

SEMESTER – 5

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) When a UJT is used for triggering an SCR, the waveshape of the voltage obtained from UJT circuit is a

a) sine wave b) sawtooth wave

c) trapezoidal wave d) square wave. ☐

ii) If gate current increases then forward break-over voltage will

a) increase b) decrease

c) remain same d) none of these. ☐

iii) A 1-phase full bridge VSI has inductor L as load. For a constant voltage source, the current through the inductor is

a) square wave b) triangular wave

c) sine wave d) pulse wave. ☐

iv) A centre tapped type single phase diode rectifier circuit is fed from a 230 V, 50 Hz source. The transformer has a voltage rating of 230 V / 50 V-0-50 V. The peak reverse voltage across the diodes is

a) $100\sqrt{2}$ V b) 100 V

c) $50\sqrt{2}$ V d) 50 V. ☐

v) In 3-phase full converter, if load current is I & ripple free, then average SCR current is given by

a) $I/2$ b) $I/3$

c) $I/4$ d) I. ☐

vi) In a commutation circuit employed to turn off an SCR, satisfactory turn-off is obtained when

a) circuit turn-off time < device turn-off time

b) circuit turn-off time > device turn-off time

c) circuit time constant < device turn-off time

d) circuit time constant > device turn-off time. ☐

vii) The advantage of a 180° conduction three phase inverter over a 120° conduction three phase inverter is that

a) it needs less number of switches

b) there is no parallelling of switches

c) devices in series are not simultaneously switched

d) load terminals are not left open during switching. ☐

viii) In a single phase full converter, the number of SCR conductings during overlap is

a) 1 b) 2

c) 3 d) 4. ☐

ix) RC snubber circuit is used to limit rate of

a) rise of current in SCR b) rise of voltage across SCR

c) conduction period d) all of these. ☐

x) Chopper control of DC motors provides variation in

a) input voltage b) frequency

c) current d) all of these. ☐

xi) In controlled rectifiers, the nature of load current

a) does not depend on type of load and firing angle delay

b) depends both on the type of load and firing angle delay

c) depends only on type of load

d) depends only on firing angle delay. ☐

xii) A 1ϕ 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. ☐

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

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

3. Discuss what would happen if gate is made positive with respect to cathode during the reverse blocking of an SCR.

4. Distinguish clearly between voltage commutation and current commutation in an SCR circuit.

5. Explain the turn-off process of an SCR with the help of anode current versus time waveform. Define the turn-off time of an SCR and circuit turn-off time. 3 + 2

6. Explain with the help of circuit diagram, the principle of operation of step-up chopper. Deduce the expression of output voltage of such chopper.

GROUP – C

(Long Answer Type Questions)

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

7. a) Describe the working of a single phase full converter in the rectifier mode with RLE load. Illustrate your answer with waveforms for source voltage, output voltage, output current, current through and voltage across one SCR. Assume continuous conduction.

   b) A 3-phase full converter is connected to a resistive load. Show that the average output voltage is given by

$$V_o = \frac{3\sqrt{3}\,V_{mp}}{\pi}\left[1 + \cos\left(\alpha + \frac{\pi}{3}\right)\right] \text{ for } \frac{\pi}{3} < \alpha < \frac{2\pi}{3}$$

   where V_{mp} = maximum of phase voltage 8 + 7

8. a) Explain with appropriate waveforms, the different control strategies used for obtaining variable voltage from a *dc* chopper. Which one of these is preferred over the other and why ?

   b) Draw neatly the circuit diagram of a four quadrant chopper and explain its operation.

   c) For a type *A* chopper, *dc* source voltage = 230 V, load resistance = 10 Ω. Take a drop of 2V across chopper when it is on. For a duty cycle of 0·4, calculate

      i) average and rms values of output voltage

      ii) chopper efficiency. 5 + 5 + 5

9. a) Discuss the principle of working of a 3-phase bridge inverter with an appropriate circuit diagram. Draw phase and line voltage waveforms on the assumption that each SCR conducts for 180° and the resistive load is star connected. The sequence of firing of various SCRs should also be indicated in the diagram.

   b) Explain how the voltage of a single phase inverter is controlled by PWM techniques ? 8 + 7

10. a) What is a cycloconverter ?

b) Describe the operating principle of a single phase to single phase step-up cycloconverter with the help of bridge type configuration. Illustrate your answer with appropriate circuit and waveforms. The conduction of various SCRs must also be indicated on the waveforms.

c) Describe how the speed of a separately excited *dc* motor is controlled through the use of two single phase converters. Discuss how two-quadrant drive can be obtained from this scheme. 2 + 6 + 7

11. Write notes on any *two* of the following : $2 \times 7\frac{1}{2} = 15$

a) HDVC transmission

b) Resonant converter

c) GTO

d) SMPS.

END