Name : .....

Roll No. : .....

Invigilator's Signature : .....

2013
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) 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 load is

a) 8·5 A b) 9·65 A

c) 3·38 A d) 6·75 A.

ii) A single phase full converter connected with a very high inductive load operates in ..... of V-I plane.

a) 4 quadrants

b) 3 quadrants

c) 2 quadrants

d) 1 quadrant.

iii) The advantage of an 180° conduction three phase inverter over an 120° conduction three phase inverter is

a) it needs less number of switches

b) there is no paralleling of switches

c) devices in series are not simultaneously switched

d) load terminals are not left open during switching.

iv) The output voltage waveform of a three phase square wave inverter contains

a) only odd harmonics

b) both add & even harmonics

c) only even harmonics

d) only triplex harmonics

v) A free wheeling diode across inductive load of a phase controlled converter will provide

a) quick turn-on of SCR

b) slow turn-off of SCR

c) reduced utilization factor of transformer

d) improved power factor.

vi) Switching mode power supplies are superior to linear power supplies in respect of

a) size and efficiency b) efficiency & regulation

c) regulation & noise d) noise & cost.

vii) HVDC transmission is preferred to EHV-AC transmission because

a) HVDC terminal equipment are expensive

b) VAR compensation is not required for HVDC systems

c) system stability can be improved

d) both (b) & (c)

viii) Presence of drift layer in a power semiconductor device

a) increases breakdown voltage rating

b) increases on state current rating

c) increases switching speed

d) decreases on state resistance.

ix) The switching frequency of a MOSFET will be reduced with

a) an increase in the output impedance of the device

b) an increase in the discharge rate of the input capacitance.

c) an increase in the source resistance

d) a decrease in the discharge rate of the input capacitance.

x) For a two quadrant type-A chopper, regenerative braking is

a) possible at low speeds

b) possible at high speeds

c) possible at both high & low speeds

d) not possible at all.

xi) The range of firing angle for RC firing circuit is

a) 0° – 90° b) 90° – 180°

c) 0° – 180° d) 45° – 90°.

xii) RC snubber circuit is used to limit rate of

a) rise of current in SCR

b) rise of voltage across SCR

c) rise of capacitance of depletion layer

d) all of these.

GROUP – B

(Short Answer Type Questions)

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

2. Discuss briefly with relevant waveforms, the voltage commutation technique used for the commutation of SCRs.

3. Compare the features of an IGBT with a power transistor.

4. Explain briefly the working of class *C* chopper with relevant diagrams.

5. Describe the effect of source inductance on the *dc* output voltage of a single phase full controlled bridge converter.

6. Explain with relevant circuit diagrams & waveforms, the principle of operation of single phase to single phase step-up cycloconverter.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) With the help of associated waveforms & circuit diagrams, explain the principle of operation & derive the expression of average output voltage of a 3 phase full converter supplying a very high inductive load.

   b) A three phase fully controlled SCR bridge converter is supplied with 230 V (RMS) per phase. The source inductance per phase is 0·005 H. The load is highly inductive with constant load current of 20A. Compute –

      i) firing angle for an output voltage of 436 V

      ii) overlap angle. 7 + 8

8. a) Discuss with appropriate circuit diagram the principle of operation of a three phase bridge inverter connected with star connected resistive load. The period of conduction of each SCR is 180°. Draw phase & line voltage waveforms of the load. The sequence of firing of various SCRs should also be indicated in the diagram.

   b) Explain the working of a resonant pulse inverter. 9 + 6

9. a) What is the principle of operation of boost regulator ? Deduce the expression of output voltage.

   b) The step-down chopper has a resistive load of 10 ohm & the input voltage is 200V. When the chopper is turned on, the voltage drop a cross the switch is 1V, the chopping frequency is 1 kHz. If the duty cycle is 40%, determine the average output voltage, rms output voltage, efficiency of the chopper & effective input resistance of the chopper. 7 + 8

10. a) Explain with appropriate circuit diagram & waveforms, techniques to improve power factor of phase controlled converters.

    b) How are control of output voltage & harmonic reduction in the output voltage achieved in the inverter ? 8 + 7

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

a) Speed control of AC motor with power electronic devices.

b) Multi-phase choppers

c) Three phase AC controllers

d) Parallel operation of SCRs

e) GTO.