Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (EEE/EE-OLD)/SEM-5/EE-504/2010-11

2010-11

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 an SCR, holding current is

      a) equal to latching current I_2

      b) less than I_2

      c) more than I_2

      d) not related to I_2.

   ii) 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.

iii) 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.

iv) Thyristor *A* has a rated gate current of 2A and Thyristor *B* has a rated gate current of 100 mA.

a) *A* is a GTO and *B* is a conventional SCR

b) *B* is a GTO and *A* is a conventional SCR

c) *A* may operate as a transistor.

v) Each SCR of 3Φ full-wave rectifier conducts for

a) 60° b) 120°

c) 180° d) 90°

vi) In a controlled rectifier circuit, a free-wheeling diode is not necessary if the load is

a) inductive b) resistive

c) capacitive d) any of these.

vii) An IGBT has three terminals called

a) collector, emitter, base

b) drain, source, base

c) drain, source, gate

d) collector, emitter, gate.

viii) A chopper has V_s as the source voltage, R as the load resistance and α as the duty cycle. The rms value of the output voltage is

a) $d.V_s$ b) $\sqrt{\alpha}\,.V_s$

c) $V_s/\sqrt{\alpha}$ d) $\sqrt{1-\alpha}\,.V_s$.

ix) The advantage of 180° conduction mode of 3-ph inverter circuit over 120° conduction mode is

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.

x) The forward voltage drop across an SCR in the on state

a) increases slightly with load current

b) decreases slightly with load current

c) remains unchanged

d) changes linearly with load current.

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

a) increase b) decrease

c) remain same d) none of these.

xii) 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.

GROUP – B

(Short Answer Type Questions)

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

2. Draw a comparison between power transistor, power MOSFET & IGBT in relation to their application in power electronics.

3. With the help of relevant waveforms discuss the static and dynamic characteristics of SCR.

4. Explain the effect of source inductor in the operation of a 1-ϕ full converter.

5. Distinguish clearly the voltage & current communication in an SCR circuit.

6. Explain with suitable circuit diagram of waveforms, the operation of a step-down chopper.

GROUP – C

(Long Answer Type Questions)

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

7. a) What is Triac ? Explain the triggering modes of Triac. What are the advantages & disadvantages of Triac over SCR ?

b) A 1-ϕ fully controlled bridge rectifier supplies load *R*. By assuming the constant output current as 10, find the following performance factors, if the supply voltage is 230 V and if the firing angle is π/6 & *R* = 5 Ω.

i) Average output voltage (E_{dc})

ii) Supply r.m.s. current

iii) Supply fundamental current

iv) Fundamental power factor (or) displacement factor

v) Input power factor

vi) Voltage ripple factor. 2 + 3 + 4 + 6

8. a) How many SCR's are required for a full-wave controlled rectifier ? Explain its operation briefly with suitable waveforms.

b) A 1-ϕ half-wave converter is with resistive load. If the delay angle is $\pi/4$, find the

i) Rectifier efficiency

ii) Form factor

iii) Ripple factor

iv) Transform utilization factor

v) Peak inverse voltage (PIV)

when supply voltage is E_s = 230 V, R = 5Ω. 3 + 6 + 6

9. a) What is chopper ? What are the classifications & commutation technique of chopper ?

b) A step-up chopper has a supply voltage of 250 while the output voltage is of 400 V. If the total time period of the chopper is 100 μsec, determine pulse width of the output voltage.

If the pulse width is reduced to 1/3 for the constant frequency operation, find the output voltage.

3 + 3 + 3 + 6

10. a) Explain briefly the function of a cycloconveter.

b) With the help of output waveform explain the operation of a 3-phase to single phase controlled cycloconverter.

c) What do you mean by blocked group and circulating current mode of operation of cycloconverter ? 3 + 8 + 4

11. 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