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Paper Code : EE-603

POWER ELECTRONIS

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) An IGBT has three terminals called

      a) collector, emitter and base

      b) drain, source and base

      c) drain, source and gate

      d) collector, emitter and gate.

   ii) In an SCR

      a) latching current $L\ I$ is associated with turn-off process and holding current $H\ I$ with turn-on process

      b) both $L\ I$ and $H\ I$ are associated with turn-off process

      c) $H\ I$ is associated with turn-off process and $L\ I$ with turn-on process

      d) both $L\ I$ and $H\ I$ are associated with turn-on process.

   iii) For an SCR, (dv/dt) protection is achieved through the use of

      a) *RL* in series with *SCR*

      b) *RC* across *SCR*

      c) *L* in series with *SCR*

      d) *RC* in series with *SCR*.

   iv) In a CSI, if frequency of output voltage is *f*Hz, then frequency of voltage input to CSI is

      a) f b) $2f$

      c) $f/2$ d) $3f$.

v) The reverse recovery characteristics of a power diode is due to

a) stored charge in depletion layer

b) stored charge in semiconductor layers

c) stored charge in both depletion and semiconductor layers

d) none of these.

vi) 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) harmonic problem is avoided.

vii) A freewheeling diode is placed across the *dc* load

a) to prevent reversal of load voltage

b) to permit transfer of load current away from the source

c) both (a) and (b)

d) none of these.

viii) The features of chopper drives are

a) smooth control but slow response

b) smooth control but fast response

c) fast response with smooth control but less efficient

d) none of these.

ix) In *dc* chopper, the load voltage is governed by

a) number of thyristors used in the circuit

b) duty cycle of the circuit

c) *dc* voltage applied to circuit

d) none of these.

x) In resonant pulse inverters

a) *dc* output voltage variation is wide

b) the frequency is low

c) output voltage is never sinusoidal

d) *dc* saturation of transformer core is minimized.

xi) Cycloconverter converts

a) *ac* voltage to *dc* voltage

b) *dc* voltage to *dc* voltage

c) *ac* voltage to *ac* voltage at same frequency

d) *ac* voltage at supply frequency to *ac* voltage at load frequency.

xii) The metal oxide varistor (MOV) is used for protecting

a) gate circuit against over currents

b) gate circuit against overvoltages

c) both (a) and (b)

d) none of these.

GROUP – B

(Short Answer Type Questions)

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

2. Describe the different modes of operation using static *V-I* characteristics of thyristor. What is the effect of gate current on the characteristics ?

3. Draw and explain circuit diagram for the synchronized UJT triggering. Also draw the associated voltage waveforms.

4. Discuss a comparison between power transistors, power MOSFET & IGBT in relation to their application in power electronics.

5. How the power factor of a single phase half-wave converter can be improved using freewheeling diode ? Explain with proper circuit diagram and waveforms.

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

GROUP – C

(Long Answer Type Questions)

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

7. a) Describe the different modes of operation using static *V-I* characteristics of Thyristor. What is the effect of gate current on this characteristics ? 5 + 2

   b) How di/dt and dv/dt protections are achieved in SRC ? 4 + 4

8. a) A single-phase fully controlled bridge converter supplies an inductive load. Assuming that the output current is virtually constant and is equal to I_d. Determine the following performance measures if the supply voltage is 230V and if the firing angle is maintained at $\pi/6$ radians.

   i) Average output voltage

   ii) Supply RMS current

   iii) Supply fundamental RMS current

   iv) Fundamental power factor

   v) Supply power factor

   vi) Supply harmonic factor

   vii) Voltage ripple factor. 8

   b) What is the difference between semi-converter and full-converter ? Why semi-converter is single quadrant whereas full-converter is two quadrant converters ? 3 + 4

9. a) What is the principle of operation of boost regulator ? 5

b) A *dc* battery is charged from a constant *dc* source 220 V through a chopper. The *dc* battery is to be charged from its internal *emf* of 90 V to 122 V. The battery has internal resistance of 1Ω. For a constant charging current of 10*A*, calculate the range of duty cycle. 5

c) Explain briefly the working of class *C* chopper with relevant diagrams. 5

10. a) Explain the basic principle of step up and step down cyclo-converter. 4 + 4

b) For a single phase *ac* voltage regulator feeding a resistive load, draw the waveforms of source voltage, gating signals, output voltage, source and output currents and voltage across SCRs. 7

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

a) Series operation of SCRs

b) Chopper controlled *dc* motor

c) UPS

d) Powerdiodes

e) TRIAC.