EC-705D

POWER ELECTRONICS

Time Allotted: 3 Hours Full Marks: 70

The questions are of equal value.
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. Answer any *ten* questions. 10×1 = 10

(i) The chopper is used

(A) to obtain variable dc voltage from a source of constant dc voltage
(B) to obtain variable dc voltage from a source of constant ac voltage
(C) to obtain variable ac voltage from a source of constant dc voltage
(D) to obtain variable ac voltage from a source of constant ac voltage

(ii) Meaning of RCT is

(A) reverse conducting thyristor
(B) random collection of thyristor
(C) repeated conduction thyristor
(D) reverse conducting transistor

(iii) The function of inverter is

(A) to get variable ac voltage from dc voltage
(B) to get ac voltage from dc voltage
(C) to get variable dc voltage from ac voltage
(D) to get variable ac voltage from ac voltage

(iv) In a thyristor the ratio of latching current to holding is

(A) 0.4 (B) 1.0
(C) 2.5 (D) 6.0

(v) Static V-I characteristics of an SCR with different gate drives applied to the gate are indicated by

(A) Ig2> Ig1>Igo (B) Vg2> Vg1> Vgo
(C) Pg2> Pg1> Pgo (D) either (A) or (B)

(vi) 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) L across SCR

(vii) The average of 180° conduction mode of three phase inverter circuit over 120° conduction mode 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 terminal are not left open during switching

(viii) Chopper control of DC motors provides variations in

(A) input voltage (B) current
(C) frequency (D) all of these

(ix) Resonant converters are basically used to

(A) generate large peak voltages
(B) eliminate harmonics
(C) reduce switching losses
(D) convert a square wave into a sine wave

(x) A single phase half wave controlled rectifier has 400 sin 314t as the input voltage and R as the load. For a firing angle of 30° for the thyristor, the average output voltage is

(A) 118.85 (B) 127.38
(C) 95.54 (D) 76.43

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

(A) size and efficiency (B) efficiency and regulation
(C) regulation and noise (D) noise and cost

GROUP B
(Short Answer Type Questions)

Answer any *three* questions. 3×5 = 15

2. A thyristor is used to feed a load resistance 8Ω from a 230v single phase supply. The ratings of thyristors are: Repetitive peak current = 300A, (di/dt)max = 40A μ sec and (dv/dt)max = 150V/μ sec. Design a snubber circuit for protection of thyristor. 5

3. What is cyclo-converter? Explain the operation of a single phase step down cyclo-converter. 1+4

4. Explain with two transistor analogy of SCR, how positive feedback action takes place during turn-on an SCR 5

5. What are the advantages of resonant converters over conventional DC to DC converters? State the concept of quasi resonant converter. 3+2

6. Draw a comparison between power transistors, power MOSFET and IGBT in relation to their application in power electronics.

GROUP C
(Long Answer Type Questions)

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

7. (a) Why is three phase bridge full wave controlled rectifier called a six-pulse converter? Explain with circuit diagram and output waveforms.
   (b) A 3-phase full converter feeds power to a resistive load of 10Ω. For a firing angle delay of 30°, the load takes 5 kW. Find the magnitude of per phase input supply voltage. 8+7

8. (a) Why is a three phase bridge full wave controlled rectifier called a six-pulse converter?
   (b) Explain the operation of a single phase fully controlled bridge converter connected with R– I load. Show the possible waveforms of the output voltage, SCR current and source current for a firing angle and considering ripple free output current.
   (c) Derive expressions for average and RMS value of output voltage for converter mentioned in (b).
   (d) A battery is charged by a fully controlled single phase converter. The input supply is 50V at 50Hz. The load consists of a 30V battery and a resistance of 5Ω connected in series to lomit the current. What is the minimum possible firing angle? Compute the value of average output voltage. 2+5+4+4

9. (a) Describe with the help of necessary voltage waveforms and circuit diagram, the operation of a three phase and circuit diagram, the operation of a three phase voltage source inverter with 180° conduction mode delivering power to star connected pure resistive load.
   (b) A single phase half-wave inverter feeds a resistive load R_L = 10Ω .Source voltage is 240V DC. Determine the r.m.s. value of current. 10+5

10.(a) With the help of relevant waveforms discuss the static and dynamic characteristics of SCR.
   (b) Draw a comparison between power transistor, power MOSFET and IGBT in relation to their application in power electronics.
   (c) Explain the effect of source inductor in the operation of a 3-phase full converter.

11. Write short notes on any *three* of the following: 3×5
   (a) RC triggering
   (b) UPS
   (c) Induction heating
   (d) MOSFET
   (e) Electronic ballast