POWER ELECTRONICS
(ELEC 3104)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking **at least one** from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

    (i)   Which of the following has the highest reverse recovery time?
            (a) Schottky diode   (b) Fast recovery diode
            (c) GP diode   (d) Normal diode.

    (ii)   Rise time of SCR is the time taken by
            (a) the anode current to rise from 10% to 90% of its final value
            (b) the gate current to rise from 10% to 90% of its final value
            (c) the anode current to rise from 10% to 50% of its final value
            (d) the anode voltage to rise from 10% to 90% of its final value.

    (iii)   Which power electronic device has the highest switching frequency?
            (a) Power MOSFET   (b) Power BJT
            (c) SCR   (d) IGBT.

    (iv)   Power electronic device with poor turn off gain is
            (a) GTO   (b) Power MOSFET
            (c) Power BJT   (d) SCR.

    (v)   In a single phase semi-converter, for continuous conduction, each SCR conducts for
            (a) α (b) π
            (c) $\pi + \alpha$ (d) $\pi - \alpha$.

    (vi)   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 60° for the SCR, the average output voltage will be
            (a) $400/\pi$ (b) $300/\pi$
            (c) $240/\pi$ (d) $200/\pi$.

(vii) The input output voltage relationship for a boost chopper is
(a) $V_o = V_s$ (b) $V_o = \alpha V_s$ (c) $V_o = V_s/(1-\alpha)$ (d) $V_o = \alpha V_s/(1-\alpha)$.

(viii) A single phase inverter with square wave output voltage will have its output waveform a fifth harmonic component equal to ____ percentage of fundamental
(a) 10%   (b) 20%   (c) 30%   (d) 40%

(ix) A single phase AC voltage controller feeds power to a resistance of 10Ω. The source voltage is 200V rms. For firing angle of 90° the rms value of Thyristor current in ampere is
(a) 20 A   (b) 15 A   (c) 10 A   (d) 5 A.

(x) The number of thyristors required in a three phase to three phase 3 pulse type cycloconverter is
(a) 6   (b) 12   (c) 18   (d) 36.

Group – B

2. (a) Draw and explain gate triggering circuit of SCR using UJT.

   (b) Explain resonant pulse commutation of SCR with necessary waveforms.

   (c) What are snubber circuits?

   5 + 5 + 2 = 12

3. (a) Explain two transistor model of SCR with the help of a neat diagram. Hence derive an expression of anode current.

   (b) The MOSFET cell embeds a parasitic BJT in its structure. Justify the statement.

   (c) What is softness factor?

   (4 + 4) + 3 + 1 = 12

Group – C

4. (a) Explain the operation of a full wave midpoint type controlled converter with RL load. Draw relevant waveforms.

   (b) A single phase transformer with secondary voltage of 230V, 50Hz supplies a half wave rectifier circuit and delivers power to a load of 10Ω. For firing angle delay of 60°, calculate (i) Rectifier efficiency (ii) Form Factor (iii) Voltage ripple factor (iv) Transformer utilization factor and (v) PIV of thyristor.

   5 + 7 = 12

5. (a) Define firing angle.

   (b) An SCR is used to control the power of 1kW, 230V, 50Hz heater. Determine the heater power for firing angle of 45°.

(c) Derive the average value and RMS value of output voltage for a three phase fully controlled bridge converter operating under continuous conduction mode.

2 + 4 + 6 = 12

Group – D

6. (a) Explain the operation of a buck chopper with necessary equations. Also draw the inductor voltage and inductor current waveforms.

   (b) A boost regulator with an input voltage of 5V has an average output voltage of 15V and average load current of 0.5A. The switching frequency is 25kHz. If L=150μH and C=220μF. Determine
   (i) Duty cycle.
   (ii) Ripple current of inductor.
   (iii) Peak current of inductor.
   (iv) Ripple voltage of filter capacitor.
   (v) Critical values of L and C.

   6 + 6 = 12

7. (a) What are the uses of feedback diodes in an inverter?

   (b) A three phase bridge inverter delivers power to a resistive load from a 600V DC source. For a star connected load of 10Ω per phase determine for 180° mode,
   (i) RMS value of load current. Also draw load current waveform.
   (ii) RMS value of thyristor current. Also draw thyristor current waveform.
   (iii) Load power.

   (c) Write short notes on current source inverters.

   3 + (2 + 2 + 1) + 4 = 12

Group – E

8. (a) Explain the operation of single phase half wave ac voltage controller for R load along with necessary waveforms.

   (b) Derive the average and rms values of output voltage for the above case.

   (c) Write any two typical application of AC voltage controller.

   5 + 5 + 2 = 12

9. (a) Explain in detail the operation of a single phase to single phase step up bridge type cycloconverter.

   (b) Write short note on static circuit breakers.

   6 + 6 =12

Department & Section	Submission Link
EE	https://classroom.google.com/c/MTIyMDQxNjg5Njkz/a/MjcxNjA2NTUzODk0/details