

**POWER ELECTRONICS
(ELEC 3202)**

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) The di/dt protection of SCR is done by adding
 - (a) series inductor
 - (b) series capacitor
 - (c) parallel capacitor
 - (d) series resistor.
 - (ii) If gate current is increased, the anode-cathode voltage at which SCR conducts is
 - (a) increased
 - (b) decreased
 - (c) maximum
 - (d) least.
 - (iii) Which of the following is incorrect?
A thyristor may be turned on by applying
 - (a) temperature
 - (b) light
 - (c) dv/dt
 - (d) di/dt.
 - (iv) Reverse recovery current in a diode depends upon
 - (a) forward field current
 - (b) stored charge
 - (c) temperature
 - (d) PIV.
 - (v) The input output voltage relationship for a buck chopper is
 - (a) $V_o = V_s$
 - (b) $V_o = \alpha V_s$
 - (c) $V_o = V_s / (1 - \alpha)$
 - (d) $V_o = \alpha V_s / (1 - \alpha)$.
 - (vi) For continuous conduction each thyristor pair of a two pulse full converter should conduct for
 - (a) π
 - (b) $\pi - \alpha$
 - (c) α
 - (d) $\pi + \alpha$.
 - (vii) What are the uses of freewheeling diode in a rectifier?
 - (a) Prevents reversal of load voltage
 - (b) Improves power factor
 - (c) Improves efficiency
 - (d) All of the above.

- (viii) For elimination of 3rd order harmonics in a full bridge inverter using single pulse width modulation, the pulse width should be
 - (a) 135°
 - (b) 150°
 - (c) 120°
 - (d) 180°.
- (ix) In dual converters
 - (a) both rectifiers provide positive current to the load
 - (b) both rectifiers provide negative current to the load
 - (c) one rectifier provides positive current to the load and the other negative current
 - (d) one rectifier provides positive current to the source and the other negative current to the load.
- (x) In a full wave rectifier, the rectification ratio is approximately equal to
 - (a) 61%
 - (b) 71%
 - (c) 81%
 - (d) 91%.

Group - B

2. (a) Draw and explain the V-I characteristic of SCR.
 - (b) Draw and explain gate triggering circuit of SCR using resistor. What are the disadvantages of this circuit?
- 6 + 6 = 12**
3. (a) What are the different types of power diodes?
 - (b) How many SCRs are required in a series string to withstand a dc voltage of 3500 V in steady state if the SCRs have a steady voltage rating of 1000 V and the steady state derating factor is 30%? Assuming the maximum difference in the leakage current of the SCR to be 100 mA. Calculate the value of the voltage sharing resistor to be used.
 - (c) With the help of a neat equivalent circuit diagram explain the structure and principle of operation of IGBT.
- 3 + 4 + 5 = 12**

Group - C

4. (a) Describe the operation of a half wave rectifier with R-L-E load along with necessary waveforms and circuit diagram.
- (b) A single-phase semiconverter is operated from 120 V, 50 Hz ac supply. The load resistance is 10 Ω . If average output voltage is 25% of the maximum possible average output voltage, determine (i) firing angle (ii) rms and average output current (iii) rms and average thyristor current.
- (c) Define extinction angle.

6 + 5 + 1 = 12

5. (a) Explain the operation of a buck-boost chopper with necessary equations.
- (b) A step down dc chopper has a resistive load of $R = 15 \Omega$ and input voltage of 200 V. When the chopper is ON the voltage drop across it is 2.5 V. The chopper frequency is 1 kHz. If duty cycle is 50%, calculate (i) average output voltage (ii) RMS output voltage (iii) chopper efficiency.

5 + 7 = 12

Group – D

6. Explain the operation of three phase VSI for 180° mode of operation with waveforms for gate currents, phase voltages and line voltages.

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7. (a) Explain the operation of single phase half bridge inverter for R load along with waveforms and necessary circuit diagram.
- (b) Derive the equation for instantaneous output voltage of half bridge inverter in fourier-series form. Also find out the RMS value of the fundamental component.
- (c) What are the uses of feedback diodes in an inverter?

4 + 6 + 2 = 12

Group – E

8. (a) Explain the operation of single-phase full-wave ac voltage controller for R load along with necessary waveforms and circuit diagram.
- (b) A single phase half wave ac voltage controller feeds a load of $R = 20 \Omega$ with an input voltage of 230 V, 50 Hz. Firing angle for both the thyristors is 30° . Calculate:
- (i) RMS value of output voltage.
- (ii) Power delivered to load and input power factor.
- (iii) Average input current.

6 + 6 = 12

9. (a) Explain in detail the operation of a single phase to single phase step up bridge type cycloconverter.
- (b) Explain High Voltage D.C transmission in detail.

6 + 6 = 12