

9. (a) Explain in detail the operation of a single phase to single phase step up bridge type cycloconverter.
- (b) Explain in detail the working of an uninterruptible power supply. Also mention its types.

6 + 6 = 12

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) For thyristors, pulse triggering is preferred to dc triggering because
 (a) gate dissipation is low
 (b) pulse system is simpler
 (c) triggering system is required for a very short duration
 (d) ease of generation.
- (ii) SCR is turned-off when the anode current falls below
 (a) forward current rating
 (b) breakover voltage
 (c) holding current
 (d) latching current.
- (iii) With gate open, SCR can be turned-on by making supply voltage
 (a) minimum
 (b) reverse
 (c) equal to cathode voltage
 (d) equal to break-over voltage.
- (iv) In a three-phase full converter, the six SCRs are fired at intervals of
 (a) 30° (b) 60° (c) 90° (d) 120°.
- (v) A cycloconverter can be considered to be composed of two converters
 (a) connected back to back
 (b) series connected
 (c) parallel connected
 (d) series-parallel connected.
- (vi) Power MOSFET is a
 (a) voltage controlled device
 (b) current controlled device
 (c) frequency controlled device
 (d) both voltage and current controlled device.

- (vii) In PWM method of controlling the average output voltage in a chopper the on-time is varied but the chopping frequency is
 (a) also varied (b) kept constant
 (c) neither (a) nor (b) (d) both (a) and (b).
- (viii) Schottky diodes have ____ reverse breakdown voltage and ____ switching time.
 (a) low, fast (b) high, fast
 (c) low, slow (d) high, slow.
- (ix) Snubber circuit is used to limit the rate of
 (a) rise of current (b) conduction period
 (c) rise of voltage across SCR (d) firing angle.
- (x) A SMPS operating at 20 kHz to 100 kHz range uses ____ as the main switching element.
 (a) SCR (b) MOSFET (c) Transistor (d) SIT.

Group - B

2. (a) Explain the two-transistor analogy of thyristor. Hence derive an equation for anode current.
 (b) Draw and explain the turn-off characteristic of SCR. What do you mean by reverse recovery time and gate recovery time?
 (c) Define latching and holding current of thyristor.
3. (a) Explain in detail complementary commutation of thyristor along with waveforms.
 (b) Derive the expression of capacitance for dynamic equalising network of thyristor.
 (c) Write in detail about the basic structure of IGBT. Also draw its V-I characteristics.

$$(2 + 3) + (2 + 3) + 2 = 12$$

$$4 + 4 + 4 = 12$$

Group - C

4. (a) What is the effect of source inductance on the output voltage of a single phase full wave converter? Derive necessary equations.
 (b) A 230 V, 50 Hz one pulse SCR controlled converter is triggered at a firing angle of 40° and load current extinguishes at 210° . Find circuit

turn off time, average output voltage, average load current for $R = 5 \Omega$, $L = 2 \text{ mH}$, $E = 110 \text{ V}$.

- (c) Define firing angle.

$$7 + 4 + 1 = 12$$

5. (a) Explain in detail the operation of class E chopper.
 (b) Derive an expression of ripple current for a buck-boost chopper.
 (c) What are the advantages of pulse-width modulation control over frequency modulation control strategies?

$$5 + 3 + 4 = 12$$

Group - D

6. (a) Explain the operation of three phase VSI with 120° mode of operation with wave forms for gate currents, phase voltages and line voltages.
 (b) Differentiate between 180° and 120° mode of conduction for a three phase VSI.
7. (a) Explain the operation of single phase full bridge inverter with R-L load along with waveforms.
 (b) A single phase full bridge inverter is operated from a 96 V battery and is supplying power to a pure resistive load of 10Ω . Determine (i) the fundamental output voltage (ii) rms value of output voltage. (iii) output rms power.
 (c) Explain the method of multiple pulse modulation technique with necessary equations.

$$10 + 2 = 12$$

$$5 + (1 + 1 + 1) + 4 = 12$$

Group - E

8. (a) Explain the operation of single-phase full-wave ac voltage controller with R load along with necessary waveforms.
 (b) A single phase half wave ac voltage controller feeds a load of $R = 20 \Omega$ with an input voltage of 230V, 50Hz. Firing angle for both the thyristors is 45° . Calculate (i) rms value of output voltage (ii) power delivered to load and input power factor (iii) average input current.
 (c) What do you mean by integral cycle control?

$$4 + (2 + 2 + 2) + 2 = 12$$