

(4) Assume **suitable** additional data if **necessary**.

1. Answer any **five** of the following :—
- (a) Explain the terms 'Second breakdown' and 'SOAR' for power BJT. **4**
  - (b) Draw turn-off-time characteristics for SCR and explain different mechanisms involved in turn-off. **4**
  - (c) Explain  $\frac{dv}{dt}$  rating of SCR and explain reasons of its importance. **4**
  - (d) Sketch torque speed characteristics of required cage induction motor in **4**
    - (i)  $\frac{V}{f}$  control
    - (ii) Stator voltage control
  - (e) Give techniques of electrical braking of separately excited d.c. motors. **4**
  - (f) Compare voltage source inverters with current source inverters. **4**
2. (a) Give practical methods to measure turn-off-time,  $\frac{dv}{dt}$  rating,  $V_{AK}$ - breakover voltage of SCR. **8**
- (b) Explain effect of source inductance on performance of full converter. Draw relevant waveforms in single phase and three phase circuits. **8**
- (c) Give two methods of isolation between control circuit and power circuit. **4**
3. (a) With neat sketches of waveforms explain the working of full converter in (i) rectifier mode **10**  
(ii) inverter mode. Give conditions for successful inverting operation.
- (b) The speed of 10 HP 220 V 1500 RPM dc motor armature is driven by 3 phase full converter. **10**  
The field current of motor is also controlled by another 3 phase full converter set to maximum output voltage. Armature resistance  $R_a = 0.65$  Ohm, field resistance  $R_f = 450$  Ohms, Motor constant  $K_v = 1.2$  V/A-rad/sec. Assuming armature and field currents are continuous and ripple free, find
- (i) Delay angle of armature converter at rated speed and rated power if input is 440 V 3 phase 50 Hz.
  - (ii) no load speed if armature current at no load is 10% of rated value.
4. (a) Explain working of 3 phase bridge inverter in (i) 120 degrees mode and (ii) 180 degrees **10**  
mode using neat sketches of waveforms.
- (b) Explain working of sinusoidal PWM inverter using relevant waveforms. Give advantages **10**  
of this inverter compared to single pulse inverter.
5. (a) Draw circuit diagram of impulse commutated chopper using SCR's and explain its working **10**  
using important waveforms.
- (b) A d.c. series motor is driven by Chopper using 300 V d.c. source **10**  
The armature resistance  $R_a = 0.05$  Ohm  
and field resistance  $R_f = 0.06$  Ohm  
The armature current  $I_a = 500$  Amps.  
Assuming armature current to be continuous and ripple free and duty cycle of chopper is 60% determine speed of the motor.
6. (a) List methods of speed control of slip ring wound rotor induction motor. Give details of **10**  
each method.
- (b) A 6 pole 50 Hz 3 phase slip ring a.c. induction motor is controlled using slip power recovery **10**  
scheme. If open circuit standstill voltage is 600 V and diode rectifier has overlap angle of 10 degrees determine angle of firing advance in the inverter if inverter is connected to 440 V, 3 phase line and overlap angle of inverter is 8 degrees. Motor speed is 600 RPM.
7. Write short notes on any **three** of the following :— **20**
- (a) Techniques of harmonic reduction in 3 phase inverters.
  - (b) Vector control of a.c. induction motor
  - (c) Stepper motor—construction, working and applications.
  - (d) Cyclo converter—working and applications.