

Con. 7914-13.

BB-12400

(4 Hours)

[Total Marks : 100]

- N.B. :** (1) Question No. 1 is **compulsory**. Solve any **four** questions from remaining.  
 (2) Draw **neat** sketches, waveforms wherever **necessary**.  
 (3) **Figures** to the **right** indicate **full** marks.  
 (4) Assume additional **data** if **necessary**.

1. Answer any **four** of the following :-

- (a) Explain  $\frac{dv}{dt}$  and  $\frac{di}{dt}$  ratings of SCR, give typical values of these. 5
- (b) Comment and explain Powerfactor in Semi-converter and full converter. Which is better ? Why ? 5
- (c) In which slip power recovery scheme it is possible to operate ac. motor above synchronous speed ? Draw block diagram of the scheme. 5
- (d) Draw torque-speed characteristics of separately excited dc motor and explain the two regions of operation. 5
- (e) Compare IGBT and SCR. 5
2. (a) Explain the effect of source inductance on performance of single phase full converter operating in rectifier mode. Draw relevant waveforms. 10
- (b) 1 phase full converter is delivering constant load current. For  $0^\circ$  triggering angle, overlap angle is found to be  $15^\circ$ . Then calculate overlap angle for  $\alpha = 30^\circ, 45^\circ$  and  $60^\circ$ . Comment on the trend of overlap angle if firing angle increases. 10
3. (a) Draw circuit diagram of class A Buck converter and explain its working using relevant waveforms for continuous and discontinuous current mode of operation. 10
- (b) A separately executed dc motor is driven by full converter bridge operating on single phase 230V, 50 Hz a.c. supply. The motor rating are 110V, 950 rpm, 25A with  $R_a = 0.1 \Omega$ . Find the firing angle  $\alpha$  for following two cases :- 10
- (i) Motoring mode 700 rpm, half the full load torque.
- (ii) Braking mode 650 rpm, half the full load torque.
4. (a) Explain working of multiple pulse sinusoidal PWM inverter using suitable waveforms. How v/f control technique be used with this circuit to control a.c. induction motor? Give advantages of this circuit with compared to single pulse inverter. 10
- (b) Draw circuit diagram of parallel inverter using SCRs to provide single phase a.c. output. Explain its working and give relationships to determine L and C. What is the role of L and C in the circuit ? 10

[ TURN OVER

5. (a) A 3 phase, 400V., 15 kW, 1440 rpm, 50 Hz, Star-connected induction motor has roter leakage impedance of  $0.4 + j 1.6 \Omega$ . Starter leakage impedance and rotational losses are assumed to be religible. If this motor is energised from 120 Hz, 400V, 3 -  $\phi$  source then calculate :- 10
- (i) Motor speed at rated load.
  - (ii) The slip at which maximum torque occurs.
  - (iii) Maximum torque.
- (b) Explain working of and basic principle of a cyclo-converter with neat equivalent circuit diagram. Also draw and discuss the waveforms illustrating operation of idealised cyclo-converter with various displacement angle. 10
6. (a) A voltage commulated chopper has the following parameters : 10  
 $V_s = 220V$ . Load circuit Parameters =  $0.5 \Omega$ , 2 mH, 40V  
 Commutation Circuit Parameters :-  
 $L = 20 \mu H$ ,  $C = 50 \mu F$   
 $T_{on} = 800 \mu sec$ ,  $T = 2000 \mu sec$ .  
 For a constant, ripple free load current of 80 A. Find :-
- (i) Effective on period.
  - (ii) Total commutation interval.
  - (iii) Peak currents in main thyristor and auxilliary thyristor.
  - (iv) Turn-off times of main thyristor of auxilliary thyristor.
  - (v) Time needed per recharge of capacitor to  $V_s$ .
- (b) Draw and explain three-phase bridge voltage source inverters and explain its modes  $120^\circ$  and  $180^\circ$ . 10
7. Write short notes (any **three**) :- 20
- (a) Speed control of static Kramer Drive.
  - (b) Vector control of a.c. induction motor.
  - (c) Safe operating area rating in power BJT.
  - (d) Stepper Motors - Principle of operation and working.
  - (e) Power factor improvement techniques in converter.