

(3 Hours)

Total Marks:80

NB: 1. Question No. 1 is compulsory

2. Answer any **THREE** questions out of the remaining **FIVE** questions.

3. Assume suitable data if **necessary** and **justify** them

4. **Figure to the right indicates marks**

- Q1** Solve any **FOUR** of the following
- a) Explain the multi quadrant speed torque characteristics and equations of separately excited DC motor. **5**
 - b) Enlist the classes of motor duty and draw the torque v/s temperature characteristics along with suitable example. **5**
 - c) Explain the closed loop torque control. **5**
 - d) Explain the stator voltage control of 3 phase induction motor. **5**
 - e) State the essential parts of electrical drive and explain the function of power modulator. **5**
 - f) Describe the principle of vector control in AC drives. **5**
- Q2 a)** Explain the operation of closed loop speed control scheme of DC motor with inner current control loop with the block diagram. Describe the functions of inner current control loop. **10**
- b)** A drive has following parameters: **10**
 $J=10 \text{ kgm}^2$, $T= 100 - 0.1N$, N-m and passive load torque of $T_L=0.05N$, N-m.
 where, N is the speed in rpm. Initially the drive is operating in steady state. Now the drive is to be reversed. For this the motor characteristic is changed to $T= -100-0.1N$, N-m. Calculate the time of reversal.
- Q3 a)** Explain the 3 phase fully controlled rectifier control of a separately excited DC drive in detail with suitable diagram and waveforms and derive the relation for the output voltage, current and speed. **10**
- b)** A drive has the following equations for motor and load torques. **10**
 $T= 1+2\omega_m$; $T_l = 3 \sqrt{\omega_m}$ where ω_m is the motor speed in rad/s. Obtain the equilibrium points and determine their steady state stability.
- Q4 a)** Explain the concept of load equalization. Derive the relation for the moment of inertia of the flywheel. **10**
- b)** Explain the component of load torque. Also, draw the nature and classification of load torque. **10**
- Q5 a)** A 3 phase, delta connected, 400V, 50 Hz, 6 pole, 925rpm, squirrel cage induction motor has following ratings and parameters: **10**
 $R_s= 0.2 \text{ ohm}$, $R_r' = 0.3 \text{ ohm}$, $X_s=0.5\text{ohm}$, $X_r' = 1 \text{ ohm}$.
 Motor is controlled by a voltage source inverter at constant V/f ratio. Inverter allows frequency variation from 10Hz to 50 Hz and constant voltage of 400V above 50Hz. In motoring mode, calculate
- 1. Break down torque for the frequency of 100Hz.
 - 2. Frequency for a speed of 850rpm and full load torque
 - 3. Torque for frequency of 45Hz and 900rpm.
- b)** Explain with block diagram, the principle of Direct torque control method. **10**
- Q6 a)** Compare scalar and vector control of 3 phase induction motor drive. **10**
- b)** Explain plugging of 3 phase induction motor with the circuit diagram and the speed- torque characteristics. **10**
