

(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

- 1 (a) Discuss the factors affecting the choice of an electrical drive with examples. 5
- (b) Write the dynamic torque equation. Then, show how the time in a transient operation is calculated. 5
- (c) Explain three phase fully controlled converter fed DC motor. 5
- (d) Illustrate with block diagram anyone closed loop speed control of drives. 5
- 2 (a) Explain the four quadrant operation of a motor with suitable example and discuss how a chopper fed motor can be used for this application. 10
- (b) A drive has following parameters: 10
 $J=10 \text{ kg-m}^2$, $T=100-0.1N$, N-m, Passive load torque $T_l=0.05N$, N-m, where N speed in rpm. Initially the drive is operating in steady state. Now it is to be reversed. For this motor characteristics is changed to $T=-100-0.1N$, N-m. Calculate the time of reversal.
- 3 (a) Discuss the thermal model of electric machine. Illustrate how motor gets hot and cools down. Define heating and cooling time constants. 10
- (b) Derive the expression for the overload factor for short time duty of a motor. 10
- 4 (a) A 2.8 kW, 400 V, 50 Hz, 4 pole, 1370 rpm delta connected squirrel cage induction motor has following parameters referred to the stator: $R_s = 2\Omega$, $R_r' = 5\Omega$, $X_s = X_r' = 5\Omega$, $X_m = 80 \Omega$. Motor speed is controlled by stator voltage control. When driving a fan load it runs at rated speed at rated voltage. Calculate motor terminal voltage, current and torque at 1200 rpm. 10
- (b) Why load equalization is required and derive the moment of inertia of the flywheel required for load equalization. 10
- 5 (a) Describe the Plugging of three phase induction motor and show the transition of the operating point with relevant speed torque characteristics. 10
- (b) A 3-phase 440 volt 50 hertz 6 pole star connected induction motor has following parameters referred to stator $R_s = 0.05 \Omega$, $R_r' = 0.6 \Omega$, $X_s = X_r' = 1\Omega$. If the motor is used for the regenerative braking, determine- 10
 (i) Maximum overhauling torque it can hold and range of speed in which it can operate.
 (ii) The speed at which it will hold with a load of 160 N-m
- 6 (a) Compare scalar control and vector control of AC drives. What do you mean by direct vector control? 10
- (b) Show the implementation of DTC of 3-ph induction motor: 10
