(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 **mark**

1. Solve any **four**
    (a) Problems on fluctuating loads are overcome by mounting a flywheel on the motor **5**
         shaft in non reversible induction motor drive. Explain how this is achieved?
    (b) Explain the fundamental principle of vector control of induction motor   **5**
    (c) Explain any two starting methods of induction motor.   **5**
    (d) Draw the circuit diagram of Static Scherbius Drive (Slip Power Recovery).   **5**
    (e) State and explain the disadvantages of using a motor of wrong rating   **5**

2. (a) A motor is driving a number of loads with rotational motion. One load is directly **10**
         coupled and other loads are coupled through gears. Derive the expression for the
         equivalent moment of inertia reflected on the motor shaft and the expression for
         equivalent load torque.
    (b) A drive has the following equations for motor and load torques.   **10**
         T= 1+2ω_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.

3. (a) Draw the block diagram of closed loop speed control of dc drive with inner current **10**
         control loop. Explain each block.
    (b) Illustrate the four-quadrant operation of a DC motor driving a hoist load by means of **10**
         a suitable diagram. Assume that a dual converter supplies the motor. Clearly show the
         directions & polarities of the following quantities;
            a) Speed, b) load torque, c) developed torque, d) converter output voltage,
            e) converter output current and f) back emf of the motor.

4. (a) Draw the speed torque characteristics and explain plugging of 3-ph induction motor. **10**
         Also show the speed transition from motoring mode to braking mode.
    (b) A delta connected three phase, 50Hz, 6pole, 400V, 925 rpm squirrel cage induction **10**
         motor has following parameters R$_s$ = 0.2 Ω, X$_s$ = 0.5 Ω, R$_r$' = 0.3 Ω, X$_r$' = 1 Ω. The
         motor is fed from a voltage source inverter with constant V/f ratio from 0 to 50 Hz
         and constant voltage of 400V above 50 Hz frequency. Determine
            i.   Breakdown torque for a frequency of 100 Hz as a ratio of its value at 50 Hz
            ii. Calculate the motor torque at 30 Hz and slip speed of 60 rpm.

5. (a) What do you mean by short time duty and derive the relation for the overloading **10**
         factor.

    (b) Derive the open loop block diagram of a separately excited DC motor and obtain the **10**
         transfer function $\frac{\omega(s)}{V_r(s)}$ where ω is the speed in rad/s and V$_r$ is the reference voltage to
         set the reference speed.

6. (a) Draw the block diagram and explain DTC of 3-ph induction motor   **10**
    (b) Explain single phase fully controlled converter drive and its performance   **10**
         characteristics in continuous mode.

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