B-E Sem-VII C Scheme Summer 2025 ELEC 21/6/25

(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 Solve Any **Four** **20**

(a) What are the main factors which decide the choice of electrical drive for a given application? **5**

(b) Draw the block diagram of an electrical drive. State the functions of each block. **5**

(c) Illustrate load equalization with neat sketches of T, T_l and ω_m waveforms. When and why it is required? **5**

(d) A DC motor driven EV is coming down a gradient which is steep. Identify the quadrant of operation and explain briefly the operation. **5**

(e) Write the two phase equations (d-q model) and draw the d-q equivalent circuit of induction motor in either stationary reference frame or synchronously rotating reference frame **5**

2 (a) Illustrate the four-quadrant operation of a DC motor driving a hoist load by means of a suitable diagram. **10**

(b) A drive has the following equations for motor torque (T) and load torque (T_l). $T = -1 - 2\omega_m$; $T_l = -3\sqrt{\omega_m}$ where ω_m is the motor speed in rad/s. Obtain the equilibrium points and determine their steady state stability. **10**

3 (a) Half hour rating of a motor is 200 kW. Heating time constant is 80 min. The maximum efficiency occurs at 75% of full load. Determine the continuous duty rating of the motor. **10**

(b) Derive the thermal model of motor for heating and cooling and draw the heating and cooling curves. State the assumptions made. **10**

4 (a) Draw a neat block diagram of the closed loop speed control of an electric drive with an inner current control loop. State the functions of each block. **10**

(b) Illustrate with neat circuit diagram and relevant voltage waveforms, the working of three phase fully controlled rectifier fed DC separately excited motor. In which all quadrants it will operate? **10**

5 (a) Draw the speed-torque characteristics of an induction motor in quadrant I (motoring). What will happen if the phase sequence of the motor is reversed. Illustrate the transition with speed torque characteristics. What will be the effect if external rotor resistance is added to the rotor resistance during the reversal of phase sequence. **10**

(b) A 3-phase, 400V, 50 Hz, 4 pole, 1370 rpm star connected squirrel cage induction motor has following parameters referred to stator: $R_s = 2\ \Omega$, $R_r' = 3\Omega$, $X_s = X_r' = 3.5\Omega$. The motor is fed from a voltage source inverter with constant V/f ratio. The inverter allows frequency variation only from 10 to 50 Hz. Soft starting is used for the motor. Calculate the starting torque and current of this drive as a ratio of their values when motor is started at rated voltage and frequency. **10**

6 (a) Draw the block diagram and explain Direct torque and flux control of 3-ph induction motor **10**

(b) Explain with block diagram and phasor diagram the working principle of direct vector control **10**

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