



CBCS SCHEME

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17EE82

Eighth Semester B.E. Degree Examination, Dec.2023/Jan.2024

Industrial Drives and Applications

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. With basic block diagram, explain the essential parts of electric drive. (06 Marks)
b. Explain the speed torque convention and multi-quadrant operation of a drive operating a hoist load. (10 Marks)
c. A drive has the following parameters :
 $J = 10\text{Kg m}^2$, $T = 100 - 0.1N$, N-m, Passive load torque $T = 0.05N$, N-m, where N is the speed in rpm. Initially the drive is operating in steady state. Now it is to reversed, for this motor characteristics is changed to $T = -100 - 0.1N$, N-m. Calculate the time of reversal. (04 Marks)

OR

- 2 a. What are the advantages of electric drive system? (04 Marks)
b. Obtain the expression for equivalent load torque and equivalent moment by inertia of a motor drive with i) Translational and ii) rotational loads. (08 Marks)
c. A Motor equipped with a flywheel in to supply a load torque of 1000 N-m for 10sec followed by a light load period of 200N-m long enough for the flywheel to region its steady state period. It is desired to limit the motor torque to 700N-m. What should be the moment of inertia of the flywheel? Motor has an inertia of 10Kg m^2 . It's no load speed is 500rpm and the step at the torque of 500N-m is 50%. Assume speed torque characteristics of motor to be a straight line in the region of interest. (08 Marks)

Module-2

- 3 a. With usual notations derive expressions for the temperature rise of a machine. Sketch the temperature rise Vs time curve. (10 Marks)
b. Explain the method of determination of overloading factor 'K' for short time duty loads. (06 Marks)
c. A constant speed motor has the following duty cycles.
i) Load rising linearly from 200 to 500kW for 4 mins
ii) Uniform load of 400 kW for 2 mins
iii) Regenerative power returned to the supply reducing linearly to 400kW to 0 kW for 3 mins
iv) Remains idle for 4 mins
v) Calculate the power rating of the motor. Assuming loss to be properties to $(\text{Power})^2$. (04 Marks)

OR

- 4 a. Explain the single phase fully controlled rectifier of separately excited DC motor. Also obtain for average output voltage ' V_a ' and speed W_m . Assume discontinuous mode of operation. (10 Marks)
b. A 230V, 1200rpm, 15A separately excited DC motor has an armature resistance of 12Ω . Motor is operated under dynamic braking with chopper control. Braking resistance has valve of 20Ω . Calculate :
i) Duty ratio of chopper of motor speed of 1000rpm and braking torque = 15 times the rated motor torque
ii) Motor speed for duty ratio of 0.5 and motor torque equals to its rated torque. (10 Marks)

Module-3

- 5 a. Explain the effects of unbalanced voltages and single phasing on Induction motor performance. (10 Marks)
- b. A 2200V, 260kW, 735rpm, 50Hz, 3pole, 3-phase squarrel cage IM has the following parameters referred to stator
 $R_s = 0.075\Omega$, $R'_r = 0.1\Omega$, $X_s = 0.45\Omega$, $X'_r = 0.55\Omega$. Stator winding is delta connected and consists of two sections connected in parallel.
- i) Calculate the starting torque and maximum torque as a ratio of rated torque, if the motor is started by star data switching what is the maximum value of line current during starting
- ii) If motor is starting by connecting series reactors in line what should be the value of reactors so as to limit the line current to twice the rated value. (10 Marks)

OR

- 6 a. Explain the following with respect to 3 ϕ IM
- i) Regenerative Braking (10 Marks)
- ii) Plugging
- b. A 2200V, 50Hz, 3 phase, 6 pole Y connected squarrel cage IM has the following parameter :
 $R_s = 0.075\Omega$, $R'_r = 0.12\Omega$, $X_s = X'_r = 0.5\Omega$ the combined inertia of motor load is 100Kg m^2
- i) Calculate the time and energy dissipated in the motor during starting
- ii) Calculate the time taken and energy dissipated in the motor when it is stopped by plugging. (10 Marks)

Module-4

- 7 a. Explain the operation of VSI fed IM drives. Also sketch the various schemes of VSI fed IM drives. (10 Marks)
- b. Explain the current regulated VSI control of IM drive. (10 Marks)

OR

- 8 a. Explain the 3-phase IM fed from a variable frequency CSI. (10 Marks)
- b. A 1 phase, 220V, 50Hz, 1425rpm IM has the following parameters :
 $R_s = 0.2\Omega$, $R'_r = 5\Omega$, $X_s = X'_r = 6\Omega$ and $X_m = 60\Omega$. It drives a fan load at rated speed when full voltage is applied. Motor speed is controlled by stator voltage control. Calculate the motor terminal voltage for a speed of 1200rpm. (10 Marks)

Module-5

- 9 a. Explain self controlled synchronous motor drive employing load committed thyristor inverter. (10 Marks)
- b. Describe the operation of variable reluctance stepper motor. What is microstepping? (10 Marks)

OR

- 10 a. Explain the torque versus stepping rate characteristics of a stepper motor. What is slew range and ramping? (08 Marks)
- b. Write short notes on : (12 Marks)
- i) Paper mill ii) Cranes and hoists

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