CBCS SCHEME

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BEE702

ACHARYA INSTITUTE OF TECHNOLOGY Library Date ..... BANGALORE

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Industrial Drives and Applications

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Derive the fundamental torque equations of a motor load system.	4	L3	CO2
	b.	Explain the speed torque conventions and multi quadrant operations of a motor, driving a hoist load.	10	L2	CO2
	c.	A drive has following parameters J = 10 kg-m^2 , T = 15 + 0.05 N, N – m and T_l = 5 + 0.06 N-m where N is the speed in rpm. Initially the drive is working in steady state. Torque of the motor in braking is given by T = -10 – 0.04N, N-m, when the drive is braked by electric braking. Estimate the time taken by the drive to stop.	6	L3	CO2
		OR			
Q.2	a.	State the advantages of an electric drive. Mention the factors on which choice of an electric drive depends.	7	L1	CO1
	b.	Explain the operation of phase – locked loop speed control scheme. State its applications.	6	L2	CO1
	c.	Derive the expression for the equivalent load torque and equivalent moment of Inertia for loads with translational and rotational motion.	7	L3	CO2
		Module – 2			
Q.3	a.	Explain the operation of single phase half controlled rectifier control of separately excited dc motor for continuous conduction.	8	L2	CO3
	b.	Explain the rectifier control of dc series motor and draw its speed – torque characteristics.	8	L2	CO3
	c.	A 200V, 875 rpm , 150A separately excited dc motor has an armature resistance of 0.06Ω. It is fed from a single phase fully controlled rectifier with an ac voltage of 220V, 50Hz. Assuming continuous conduction , Evaluate : i) Firing angle for rated motor torque and 750 rpm. ii) Motor speed for α = 160° and rated torque.	4	L3	CO3
		OR			
Q.4	a.	Explain the dynamic braking of separately excited motor by chopper control.	6	L2	CO3

	b.	A 220V, 600 rpm , 50 A separately excited motor with armature resistance of 0.02Ω is fed from a 3 phase fully controlled rectifier. A three – wire three - phase ac source with a line voltage of 440 V, 50 Hz is available. A star delta connected transformer is used to feed the armature so that motor terminal voltage equals rated voltage when converter firing angle is zero. i) Calculate transformer turns ratio. ii) Determine the value of firing angle for rated torque and 400 rpm.	6	L3	CO3
	c.	Explain the dual converter scheme for multi quadrant operation of dc separately excited motor fed from fully controlled rectifier.	8	L2	CO3
		Module – 3			
Q.5	a.	Explain the operation of induction motor with unbalanced rotor impedances.	6	L2	CO3
	b.	Explain the ac dynamic braking of induction motor for two – lead connection.	6	L2	CO3
	c.	A star – connected , 3 phase , 50 Hz , 6 pole, slip ring induction motor has following data : Rating : 400 V, 50 kW , 960 rpm and $R_1 = 0.08\Omega$, $R_2 = 0.1\Omega$, $X_1 = X_2 = 0.3\ \Omega$, J = 10 kg-m^2. Motor is to be stopped from its no – load speed under reverse voltage braking operation. i) Find the value of external resistance to be inserted in rotor circuit so that the braking process will take minimum time. ii) Find energy loss in the motor.	8	L3	CO3
		OR			
Q.6	a.	For variable frequency control of induction motor, explain the following points : i) For speeds below base speed (V/f) ratio is maintained constant. ii) For speeds above base speed, the terminal voltage is maintained constant.	7	L2	CO3
	b.	A Y – connected squirrel – Cage induction motor has following ratings and parameters : 400 V , 50 Hz , 4 pole , 1370 rpm , $R_s = 2\ \Omega$, $R_r^1 = 3\ \Omega$, $X_s = X_r^1 = 3.5\ \Omega$, $X_m = 55\ \Omega$. It is controlled by current source inverter at a constant flux. Calculate motor torque , speed and stator current when operating at 30 Hz and rated slip speed.	6	L3	CO3
	c.	Explain the operation of VSI induction motor drive with regenerative braking which employs synchronous link converter feeding PWM inverter.	7	L2	CO3
		Module – 4			
Q.7	a.	Derive the torque expression for cylindrical rotor wound field motor thereby illustrate the operation of synchronous motor shifting from rotring to regenerative braking.	8	L3	CO3
	b.	A 3 phase, 5 kW, 440 V, 50 Hz , 4 pole star connected synchronous motor has stator winding resistance of 0.2 Ω, synchronous reactance of 8 Ω and a rated field current of 1A. Motor is operated under regenerative braking with its terminals connected to a bus having rated motor voltage. Field current is adjusted so that the motor operates at rated current and unity power factor. Calculate braking torque, torque angle and field current.	6	L3	CO3

	c.	Distinguish between modes of variable frequency control is synchronous motor.	6	L2	CO3
		OR			
Q.8	a.	Load commutated inverter fed synchronous motor drive is found suitable for high speed and high power application. Substantiate the statement with the help of block diagram.	6	L2	CO3
	b.	Application of stepper motor is widespread, list out the features.	7	L2	CO5
	c.	State and explain the mode of operation of switched reluctance motor drive employed at high speed.	7	L2	CO5
		Module – 5			
Q.9	a.	Discuss the factors on which energy efficiency operation of the drives depend on.	7	L2	CO4
	b.	Explain with characteristics Solar power pump drives.	7	L2	CO4
	c.	State the problems created by the Harmonics produced by non linear loads.	6	L2	CO4
		OR			
Q.10	a.	Draw and explain the schematic diagram of various stages in the reversing hot rolling mill and mention the requirement of the drives.	7	L2	CO5
	b.	Explain in detail , the types of drives used in machine tools.	7	L2	CO5
	c.	Describe the details of drive requirements used in cranes and hoists.	6	L2	CO5

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