

COLLEGE OF ENGINEERING

Department of Electrical Engineering
B.Tech Electrical

ESE : EE401-ELECTRIC DRIVES

Year: 2013-14 AUTUMN SEMESTER Date: 18th Nov. 2013

Duration: 3 hrs [2 to 5 pm]

Max. Marks: 100

Instructions:

Solve any **SIX** questions

State clearly the assumptions made, if any.

Begin new question from new page

Q1	a	A motor is used to drive a hoist. Motor characteristics are given by Quadrant I, II and IV; $T=200-0.2 N$ N-m Quadrant II, III and IV: $T=-200-0.2 N$, N-m Where N is the speed in rpm. When hoist is loaded the net load torque is 100 N-m and when it is unloaded, net load torque is -80 N-m. Obtain the equilibrium speeds for operation in all the four quadrants.	8
	b	A 3 phase 100 kW, 6 pole, 960 rpm wound rotor induction motor drives a load whose torque varies such that a torque of 3000 N-m of 10 sec duration is followed by a torque of 500 N-m of duration long enough for the motor to attain steady state speed. Calculate moment of inertia of the flywheel, if motor torque should not exceed twice the rated value. Moment of inertia of the motor is 10 kg-m ² . Assume that motor has a linear speed torque curve in the region of interest.	8
Q2	a	A 220 V, 600 rpm 500 A separately excited motor has armature and field resistances of 0.02 and 10 ohms respectively. The load torque is given by the expression $T_L=500-0.2 N$ N-m where N is the speed in rpm. Speeds below rated value are obtained by armature voltage control with full field and the speeds above rated are obtained by field control at rated armature voltage. Armature is fed from a 3 phase fully controlled rectifier with ac source voltage 170 V (line) and field is fed from a half controlled single phase rectifier with a single phase source voltage of 230 V. Drive operates under continuous conduction. Calculate firing angles for speeds a) 600 rpm b) 1200 rpm	8
	b	A 230 V, 1200 rpm, 15 A separately excited motor has an armature resistance of 1.2 ohms. Motor is operated under dynamic braking with chopper control. Braking resistance has a value of 20 ohms. Calculate duty ratio of chopper for motor speed of 1000 rpm and	8

		braking torque equal to 1.5 times rated motor torque. What will be the motor speed for duty ratio of 0.5 and motor torque equal to its rated torque?	
Q3		Compare the following [Any 3]	18
	a	VSI fed and CSI fed induction motor drives.	
	b	Direct torque and Vector control of AC drives	
	c	Cascaded H bridge type and clamping diode type multilevel inverters.	
	d	True synchronous and self-synchronous operation of synchronous motors	
Q4		Starting from 3 phase stator winding and 3 phase rotor winding, step by step develop d-q model of induction motor in synchronously rotating reference frame and derive the expression for electromagnetic torque developed by the motor in terms of d-q axes currents and flux linkages.	16
Q5	a	Give the block diagrams for direct and indirect vector control of induction motor and compare these methods.	8
	b	Derive the expression for torque developed by the salient pole synchronous motor.	10
Q6		A 3 phase 460 V, 60 Hz, four pole star connected induction motor has following parameters $R_s=1.01$, $R_r=0.69$, $X_s=1.3$, $X_r=1.94$ and $X_m=43.5$ ohms. The no load loss is negligible. The load torque, which is proportional to the speed squared is 41 N-m at 1740 rpm. If the motor speed is 1550 rpm, determine a) the load torque, b) the rotor current, c) the stator voltage, d) the motor input current, e) the motor input power, f) the slip for maximum current, g) the maximum rotor current, h) the speed at maximum rotor current.	16
Q7	a	Draw the block diagram for closed loop V/F control of induction motor and narrate the salient features of this method of speed control.	8
	b	Give the block diagram of static Scherbius drives and explain 4 quadrants of the operation.	10
Q8	a	Explain basic operation of SRM and give any topology to drive this motor.	8
	b	What are types of stepper motors? What is micro stepping operation ? Give the driving circuit for 2 phase bifilar winding stepper motor.	8
GOOD LUCK !!			