Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER– I (OLD course)• EXAMINATION – SUMMER 2015

Subject Code: 710709 **Date: 16/05/2015**

Subject Name: Electrical Drives (Power EC Group)

Time: 10:30 am to 1:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Explain the selection criteria of converter rating for given rating of motor. Also, explain how the cost of drive is governed by this.	**07**
	(b)	An induction motor is controlled using VVVF drive. Discuss how the following parameters vary in the field weakening mode with respect to the variation in frequency: (i) Terminal voltage (ii) Maximum Torque (iii) Maximum power (iv) Slip speed (iv) Stator current. Illustrate the relevant mathematical analysis.	**07**
Q.2	**(a)**	Explain various speed transitions with the help of speed-torque characteristics of separately excited dc motor for following cases: (i) Speed reversal (ii) Speed reduction	**07**
	(b)	Draw the speed-torque characteristics of a current-fed induction motor. Compare the same with the characteristics when the motor is fed by a voltage source. Comment on what portion of the characteristics the motor should be operated in. Why?	**07**
		OR	
	(b)	Explain the significance of current control in electric drive system. Explain various method of current control with suitable example and block diagram.	**07**
Q.3	**(a)**	Explain various loss components of dc motor drive. State the condition for loss minimization in adjustable speed dc drives. Also, draw and explain minimum loss control of it.	**07**
	(b)	Explain various methods for reversal of the motor emf with respect to the rectifier terminals in context of dc motors.	**07**
		OR	
Q.3	**(a)**	Explain the simultaneous control technique in dual converter to control circulating current of separately excited dc motor. Also, state advantages and disadvantages of it.	**07**
	(b)	Explain the principle of controlled flywheeling in rectifier fed dc motor. Draw current and voltage waveforms for discontinuous mode of operation for Ŭ> ɔ for following cases: (i) ɓ > ´ and (ii) ɓ < ´ And mention expression for armature voltage and speed. Also, explain the consequences of increasing load on performance of drive.	**07**
Q.4	**(a)**	Derive expression for current ripple for Time Ratio Control in chopper based dc drive.	**07**

(b) A 250 V separately excited dc motor has an armature resistance of 2.5 q. When driving a load at 600 rpm with constant torque, the armature takes 20 A. This motor is controlled by a chopper circuit with a frequency of 400 Hz and an input voltage of 250 V. **07**

(i) What should be the value of the duty ratio if one wishes to reduce the speed from 600 rpm to 450 rpm, with the load torque maintained constant.

(ii) What should be the minimum value of the armature inductance, if the maximum armature current ripple expressed as a percentage of the rated current is not to exceed 5%.

OR

Q.4 **(a)** Derive an expression for the critical speed ω_{mc} of a separately excited DC motor fed from a single-phase fully-controlled rectifier. **07**

(b) Draw and explain each block of four quadrant closed-loop speed control technique for induction motor using ac controllers. Also, mention the application area of ac controllers in ac drives. **07**

Q.5 **(a)** For voltage source inverter variable frequency drives, explain open loop variable frequency PWM inverter drive with dynamic braking. **07**

(b) Why a transformer is desired in a Static Scherbius drive? Comment on the power factor of the drive in this method and hence, mention the criteria for maximizing the power factor. **07**

OR

Q.5 **(a)** Draw and explain various stages of power flow diagram for an induction motor with a rotor injected voltage. **07**

(b) A 3-phase, 400 V, 50 Hz,10 kW, 960 rpm, star-connected wound-rotor induction motor has the following parameters: **07**

R_s = 0.4 q , R_r' = 0.6 q , $X_s = X_r'$ = 2 q

Stator to rotor turns ratio is 2.5.

The speed at full load torque is reduced to 600 rpm by injecting a voltage into the slip rings. Calculate the magnitude and frequency of the injected voltage. Assume the injected voltage is in phase with V.

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