Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER-1 (NEW) EXAMINATION – WINTER 2016

Subject Code: 2710709 **Date:06/01/2017**

Subject Name: Electrical Drives (Power Electronics Group)

Time: 2:30 pm to 5:00 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)**	Derive an expression of steady state stability of an electrical drive.	**07**
	(b)	Enlist and explain various components of load torques and their significance.	**07**
Q.2	**(a)**	Derive an expression for maximum torque of a 3-phase induction motor and justify that it is independent of rotor resistance.	**07**
	(b)	Explain various modes for discontinuous conduction of 1-phase fully controlled rectifier-fed separately excited motor for motoring operation for $\alpha<\gamma$. Draw relevant waveforms with usual notations. Also, explain the effects of change in (i) load torque (ii) firing angle α and (iii) angular speed of drive.	**07**
		OR	
	(b)	Explain various modes for regenerative braking operation of separately excited motor for $\alpha<\gamma$ and discontinuous conduction of 1-phase rectifier with controlled fly-wheeling. Draw relevant waveforms with usual notations.	**07**
Q.3	**(a)**	A 220V, 1750rpm, 20A separately excited motor is controlled by a 1-phase fully controlled rectifier with an ac source voltage of 230A, 50Hz. Armature resistance and inductance are $R_a = 2.6\Omega$ and $L_a = 28$mH, respectively. i. What should be the value of the firing angle to get the 75% of rated torque at 1150rpm? Also, Comment on nature of current in regard of continuous or discontinuous. ii. Calculate the firing angle for the rated braking torque and -1500rpm?	**07**
	(b)	Explain the significance of current control in electric drive system. Explain various methods of current control with suitable example and block diagram.	**07**
		OR	
Q.3	**(a)**	A 220V, 1750rpm, 20A separately excited motor is controlled by a 1-phase fully controlled rectifier with an ac source voltage of 230A, 50Hz. Armature resistance and inductance are $R_a = 2.6\Omega$ and $L_a = 28$mH, respectively. i. What would be motor torque for $\alpha = 45°$ and speed = 475rpm. ii. What would be motor torque for $\alpha = 45°$ and speed = 1100rpm.	**07**
	(b)	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**
Q.4	**(a)**	Explain the composite braking scheme for chopper based separately excited dc motor. Also, enlist its advantages and disadvantages.	**07**
	(b)	Write a brief note on modified Kramer drive.	**07**
		OR	
Q.4	**(a)**	Discuss the method of injection of voltage in the rotor circuit to control the speed of an induction motor in a super-synchronous region.	**07**
	(b)	Discuss the operation of a cylindrical rotor synchronous motor operating from a current source.	**07**

Q.5 **(a)** Explain the use of induction motors in fan and pump drives applications and derive expression for ratio of maximum to rated motor current. **07**

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

$R_s = 0.4\ \Omega$, $R_r' = 0.6\ \Omega$, $X_s = X_r' = 2\ \Omega$

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.

OR

Q.5 **(a)** Derive expression for current ripple for Time Ratio Control in chopper based drive. **07**

(b) A 250 V separately excited dc motor has an armature resistance of 2.5 Ω. 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 400 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 10%.

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