Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

ME Semester –I Examination Feb. - 2012

Subject code: 714502N **Date: 13/02/2012**
Subject Name: Solid State DC Drives
Time: 10.30 am – 01.00 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)** The field current of a separately excited motor is variable from zero to rated voltage. Derive the dynamic equation of the DC Motor, it's block diagram and the small signal armature-current response for a simultaneous voltage input to the field and torque disturbance, keeping the voltage applied to the armature constant. **07**

(b) A separately excited DC Motor with the following parameters: Ra=0.4 ohm, L_a=0.003H and K_b=0.7 V/rad/Sec. is deriving a load of J=0.0166 kg-m^2, B_1=0.01 N-m/rad/sec. with a load torque of 100 N.m. Its armature is connected to a DC supply voltage of 210 V and is given the rated field current. Find the speed of the motor. **07**

Q.2 **(a)** Draw equivalent circuit and output voltage waveform of an ideal dual converter, derive necessary condition of firing angles and list the disadvantages of dual converter. **07**

(b) For type-A dc chopper with RLE load and continuous load current condition, show that the per unit ripple current is maximum when duty cycle is 0.5. Also draw the necessary waveforms and circuit diagram. **07**

OR

(b) A separately excited dc motor has the following ratings and constant: 2.725 H.P., 110 V, 1200 r.p.m., R_a=0.8 ohm, R_f=100 ohm, K_b=0.764 V.s/rad, L_a=0.003 H, L_f=2.2 H. The DC Supply voltage is variable from 0 to 120 both to the field and armature, independently. Draw the torque-speed characteristics of the of the DC motor if the armature and field currents are not allowed to exceed their rated values. The rated flux is obtained when the field voltage is 120 V. Assume that the filed voltage can be safely taken a minimum of 10 V only. **07**

Q.3 **(a)** Explain current source with three phase controlled converter. **07**

(b) A DC Motor is driven form a chopper with a source voltage of 24 V DC and at a frequency of 1 kHz. Determine the variation in duty cycle required to have speed variation of 0 to 1 p.u. delivering a constant 2 p.u. load. The motor details are as follows: 1H.P., 10 V., 2400 r.p.m., 79 % efficiency, R_a=0.01 ohm, L_a=0.002 H, K_b=0.03819 V/rad/sec. The chopper is one quadrant and on state drop voltage across the device is assumed to be 1 V regardless of the current variation. **07**

OR

Q.3 **(a)** Explain four quadrant operation of DC motor. Also mention constant power and constant power region operation in the characteristic. **07**

	(b)	Why is the duty cycle usually changed by varying the on-time rather than the chopping frequency? Very small duty cycle near zero is not possible to realize in practice. What are the constraints in this case?	**07**
Q.4	**(a)**	Compare a four quadrant chopper and a phase controlled converter fed from a 3 phase ac supply with regard to the number of power devices, speed of response, control complexity and harmonics generated.	**07**
	(b)	Discuss the control design for a two quadrant chopper circuit.	**07**
		OR	
Q.4	**(a)**	Draw the circuit diagram and explain 3-phase full-wave controlled converter. Draw the waveforms of O/P voltage, O/P current and voltage across thyristor1 for $\alpha=30°$, $\alpha=90°$ and $\alpha=120°$ for continuous conduction.	**07**
	(b)	Draw circuit diagram, waveform and write the equations for 1-phase full controlled bridge converter, separately excited dc motor drive where current of the armature is assumed to be continuous and FD is connected in antiparallel with the armature of DC motor.	**07**
		OR	
Q.5	**(a)**	Give simulation block diagram of speed control of DC motor with current control loop and current limiting. Give the effect of current limiting with respect to response of the speed.	**07**
	(b)	Develop a linearized transfer model of DC series motor.	**07**
		OR	
Q.5	**(a)**	Explain synchronizing firing of circuit, pulse transformer and draw circuit for gate protection.	**07**
	(b)	Draw the basic block diagram of electric drive system and explain each block.	**07**

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