Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-I Regular Examination January / February 2011

Subject code: 710709N

Subject Name: Electrical Drives

Date: 03 /02 /2011 **Time: 02.30 pm – 05.00 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)** What is Speed regulation? Explain the concept of Closed-Loop Speed Control technique for separately excited DC motor. **07**

(b) Discuss the speed-torque characteristics of an Induction motor fed by a variable voltage variable frequency source. With appropriate mathematical analysis, show the effect of variation of frequency on torque and power capability of the motor. Also, show the relative variation of slip speed, terminal voltage and the current drawn by the motor. **07**

Q.2 **(a)** What is the significance of controlled fly-wheeling? Explain the continuous current mode of operation for motoring and regenerative braking for separately excited DC motor fed from 1-phase fully controlled rectifier. **07**

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

OR

(b) A 220 V, 960 rpm, 14.5 A separately excited dc motor has armature circuit resistance and inductance of 2 ohm and 150 mH respectively. It is fed from a single-phase half-controlled rectifier with an ac source of 230 V, 50 Hz. Calculate **07**
(i) Motor torque for $\alpha = 60^\circ$ and speed = 600 rpm.
(ii) Motor speed for $\alpha = 60^\circ$ and T = 20 N-m.

Q.3 **(a)** Draw and explain continuous and any one discontinuous mode of operation of a 3-Phase fully controlled rectifier fed dc motor. **07**

(b) A 220 V, 1500, 11.6A rpm dc motor has the armature resistance and inductance of 2 ohm and 28.36 mH respectively. It is controlled by a 3-phase fully controlled rectifier from an ac source operating at 50 Hz. Calculate the ac source voltage required to get the rated voltage across the motor terminals when operating in continuous conduction. Identify the modes of operation for the following cases: **07**
(a) $\alpha = 60$ deg, Ta = 1 N-m and
(b) $\alpha = 60$ deg, Ta = 20 N-m.
Hence, obtain speed for case (b).

OR

Q.3 **(a)** Explain semiconductor converter based controlled dynamic braking and composite braking of DC motor. **07**

(b) What is Dual converter? Draw and explain how the circulating current is controlled in dual converter with simultaneous control. **07**

Q.4 **(a)** Draw the speed-torque characteristics of an induction motor when fed by current source. 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. Why ? **07**

(b) Draw the block diagram that represents a closed-loop slip speed controlled scheme for controlling the speed of an induction motor fed by a voltage source. Clearly explain the function of each block used. **07**

OR

Q.4 **(a)** What is the effect on the motor efficiency and the current drawn from the source, when speed control of an induction motor is achieved by varying the stator (terminal) voltage (with fixed frequency)? Discuss in brief the various AC voltage controller configurations that can be employed for the stator voltage control technique. **07**

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

Q.5 **(a)** Derive the equation of torque for a wound field salient pole synchronous motor operating from a voltage source of constant frequency. Hence, draw the torque-angle characteristics for the same. **07**

(b) Write a brief note on speed control of an induction motor by static rotor resistance control. **07**

OR

Q.5 **(a)** A 3-phase 6600-V, 6 pole, 60 Hz, 1100 kW Y-connected wound field synchronous motor has the following parameters **07**

$X_m = 30\Omega$, $X_{sl} = 6\Omega$, $R_s = 1.2\Omega$,

field winding resistance $= 5\Omega$, n =2

When operating at rated power and unity power factor, calculate (i) the field current and torque angle at full load and (ii) the pull out torque. Neglect friction, windage and core loss.

(b) How can one get the motoring and regenerative braking with an Induction motor fed from a six-step voltage source inverter? Show the various schemes by which it can be achieved. Also, show the phase voltage and phase current waveforms under motoring and braking conditions. **07**

****