Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E –Ist SEMESTER–EXAMINATION – JULY- 2012

Subject code: 710709N **Date: 11/07/2012**

Subject Name: Electrical Drives

Time: 2:30 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)** Explain the various components of the load torque with suitable example and their effect on requirements of an electric drive. **07**

(b) An induction motor is controlled using VVVF drive. Discuss how the following varies in the field weakening mode with respect to the variation in frequency **07**

(i) Terminal voltage (ii) Maximum Torque

(iii) Maximum power (iv) Slip speed (iv) Stator current

Show the relevant mathematical analysis.

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 when operating in fly-wheeling mode. **07**

(b) A separately excited DC machine is fed from a 1-phase half controlled rectifier bridge. Draw the waveforms representing the output voltage and current of the converter (inputs to machine) when the machine is operating in Motoring mode. Discuss these modes in brief. **07**

OR

(b) (i) Derive the expression for current ripple for Time Ratio Control(TRC). **07**

(ii) 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. Find the value of duty ratio that reduces the speed from 600 to 400 rpm, with (a) the load torque maintained constant and (b) the load torque gets 1.5 times the rated.

Q.3 **(a)** Draw and explain the speed-torque characteristics of a 3-phase fully-controlled rectifier drive. Also find the expression for no-load speed. List the assumptions if any. **07**

(b) Explain the role of current control scheme and various methods of it for rectified controlled DC motors. **07**

OR

Q.3 **(a)** Derive an expression for the critical speed ω_{mc} of a separately excited DC motor fed from a single-phase half-controlled rectifier. **07**

(b) What is composite braking? Explain in detail with suitable example and plots. **07**

Q.4 **(a)** With neat diagram explain a closed-loop speed control employing indirect current control scheme for an induction motor fed from voltage source inverter. The scheme should also have a provision for regenerative braking. **07**

(b) Which harmonics are dominant in the output voltage of a six-step inverter? Discuss the effects of these harmonics on the performance of an induction machine fed from a six-step inverter. **07**

OR

Q.4 **(a)** Show the scheme of static Scherbius drive used for slip power recovery control of an induction motor. State the limitations of the method. What is the significance of transformer in this control scheme? **07**

(b) For a doubly fed wound rotor induction motor, discuss the sub-synchronous motoring and sub-synchronous braking operation. **07**

Q.5 **(a)** How the operation of an induction motor fed from current source is different than that when fed with a voltage source? Draw the speed-torque characteristics for both the cases on the same plot. **07**

(b) A 460V, 60Hz, 6 pole, 1180 rpm, Y-connected induction motor has the rated torque 0f 332.7 Nm. The parameters (per phase values) of the motor referred to the stator are: R_s = 0.19Ω, $R_{r'}$=0.07Ω, X_s=0.75Ω, $X_{r'}$ =0.67Ω and X_m = 20Ω. If the motor is operated using V/f drive at a constant V/f ratio, calculate the inverter frequency at half the rated torque and 500 rpm. Neglect derating due to harmonics and use the equivalent circuit. **07**

OR

Q.5 **(a)** Write a brief note on current controlled PWM inverters as a means to control the speed control of AC motors. **07**

(b) Derive the performance equations of a wound field cylindrical rotor synchronous motor operating from a source having constant voltage and constant frequency. **07**

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