**R07** 

## IV B.Tech I Semester Examinations, MAY 2011 POWER SEMICONDUCTOR DRIVES Electrical And Electronics Engineering

Time: 3 hours

Code No: 07A70201

Max Marks: 80

[8+8]

### Answer any FIVE Questions All Questions carry equal marks \*\*\*\*

- (a) Generally the stator voltage control is suitable for speed control of Induction motor in fan and pump drives. Discuss in detail why the above method is useful.
  - (b) Explain why the stator voltage control is not an efficient method of control.
- 2. Draw the circuit diagram and explain the operation of rotor- resistance control using chopper. Mention the advantages and disadvantages of the above method of control. [16]
- 3. Derive the Speed, Torque Equations of a fully controlled converter connected to separately excited D.C motor with continuous current operation with necessary waveforms. [16]
- 4. Explain the basic operational aspects of three phase fully controlled converters with neat sketches of the waveforms and the circuit diagram. What is the effect of free wheeling diode. [16]
- 5. What is continuous current operation of chopper fed DC motors? Explain with relevant waveforms. [16]
- 6. With suitable circuit diagrams discuss in detail the principle of operation of Self controlled Synchronous motor drive employing a Cyclo converter. [16]
- 7. A 50 hp 440 V, 50 Hz six pole Star connected Induction motor has the following equivalent circuit parameters:

 $R_1 = 0.1 \text{ Ohm}, R_2' = 0.12 \text{ Ohm},$ 

 $X_1 = 0.3$  Ohm,  $X_2' = 0.3$  Ohm .  $X_m = 15$  Ohm. For a slip of 0.03 at rated frequency determine the torque developed. [16]

- 8. (a) With neat circuit diagram and waveforms, explain dynamic braking of separately excited motor by single phase converter.
  - (b) A dc shunt motor has the armature resistance of 0.04Ω and the field winding resistance of 10Ω. Motor is coupled to an over hauling load with a torque of 400N-m. Following magnetization curve was measured at 600 rpm:

Field Current, A	2.5	5	7.5	10	12.5	1.5	17.5	20	22.5	25
Back emf, V	25	50	73.5	90	102.5	110	116	121	125	129
	0	-								

Calculate the value of  $R_B$  when the motor is required to hold overhauling load at 1200rpm. [8+8]

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- 1. Explain static motor resistance control for speed control of I.M. Draw speed & torque charecterstics.
- $2.\,$  Explain in detail the braking operation of a controlled separately excited d.c motor.
- 3. Explain in detail the operation of a full- converter feeding a D.C series motor with reference to voltage and current waveforms, Assuming that the motor current is a continuous one. [16]
- 4. Draw and explain the speed torque curves with variable frequency control for the two different modes.
  - (a) Operation at constant flux
  - (b) Operation at constant (V/f) ratio.
- 5. A  $3\Phi$  half wave bridge comprising three thyristors is fed from a 277Vrms, line to neural, 60Hz supply and provides an adjustable dc voltage at the terminals of a separately excited dc motor. The motor has  $R_a=0.02$ ,  $L_a=.001H$ ,  $K_a=1.2$  and full load  $I_a = 500A$ . Find the firing angle so that the motor operates at full load current and at rated speed of 200rps. Assume continuous conduction and neglect thyristor forward voltage drop. [16]
- 6. Explain the principle of operation of self control of synchronous motor fed from VSI source. [16]
- 7. A  $3\phi$ , 8 pole,  $50H_z$  IM has the following circuit parameters  $r_2=0.15\Omega x_2 = 0.7\Omega$ . The motor speed is controlled by varying the applied voltage by an AC voltage controller, which operates from a 380v,  $50H_z$  supply. Detemine the applied voltage perphase of the motor to have a slip of 0.15. The motor drives a load with a charectersite of  $T_1 = 0.014W^2NW$ -m. Determine the firing angle of the converter. [16]
- 8. A class-A chopper, operating in time-ratio control, is supplying the armature of the separately excited dc motor. Show that the motor speed-torque relationship is ,  $\omega_m = \frac{\delta . V}{K} - \frac{R_a}{K^2} T_a$

Where V - chopper input voltage, Ra - Armature resistance, Ta - motor torque, K-torque constant. [16]

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- 1. In variable frequency control of asynchronous motor why (V/f) ratio is maintained constant up to base speed and V constant above base speed. Draw the relevant characteristics. [16]
- 2. Write down the basic performance equations for a D.C Series motor Sketch characteristics of constant torque drive and constant power drive regions. [16]
- 3. Explain how braking mode of operation is obtained in D.C drives. [16]
- 4. (a) State the major features of Rotor resistance control of Wound Rotor Induction motor.
  - (b) In the rotor resistance control, what type of motor speed torque characteristics will be obtained if one phase has a loose contact? [8+8]
- 5. Discuss in detail the principle of operation of a 3 Phase Induction motor when it is operated below rated frequency and above rated frequency. Draw relevant speed torque characteristics. [16]
- 6. What is a Chopper? Explain the Chopper control of a separately excited D.C motors
  - (a) Motoring Mode
  - (b) regenerative braking mode and also draw the Speed-Torque Curves in each mode. [8+8]
- Describe how the speed of a separately excited dc motor is controlled through the use of two 3- phase full converters. Discuss how two quadrant drive can be obtained from the scheme. Derive expressions for rms values of source and thyristor currents. State assumptions made. [16]
- 8. The rotor resistance and stand still reactance referred to stator of a 3 phase, 4 pole, 50 Hz Squirrel cage Induction motor is 0.2 ohm and 0.8 ohm per phase respectively. The full load slip of the motor is 4 percent. Neglect stator resistance and leakage reactance. Determine how much stator voltage should be reduced in order to get a speed of 1200rpm if the load torque remains constant. [16]

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[16]

### Answer any FIVE Questions All Questions carry equal marks $\star \star \star \star \star$

- 1. Derive the Speed, Torque Equations of a fully controlled converter connected to D.C series motor with continuous current operation with necessary waveforms.
- 2. Mention the reasons
  - (a) Why V/f ratio is maintained constant when the motor is operated below the base speed.
  - (b) Why the terminal voltage is maintained constant, when Induction motor is operated above base speed. Draw relevant speed torque characteristics. [8+8]
- 3. Explain the operation of four quadrant chopper fed to the D.C separately excited motor and also draw the current and voltage wave forms for continuous current operation. [16]
- 4. What are the various possible combinations of voltage source DC link converters to obtain a variable voltage variable frequency supply to feed a Synchronous motor? Draw the circuit diagrams and discuss in detail. [16]
- 5. (a) Starting from fundamentals prove that torque developed by the Induction motor is proportional to square of the supply voltage.
  - (b) Draw the speed torque curves for different voltages fed from stator voltage controller. [8+8]
- 6. The field circuit and armature circuit of a separately excited dc motor are controlled by two identical three phase fully controlled converter and are fed from a 400V 50 Hz supply . The rated armature current of the motor is 170A. motor parameters are  $R_a=0.2\Omega$   $R_f=320\Omega$  motor constant is 0.5. Field converter has zero degree firing angle delay. For rated load torque of 60Nm at 2000rpm. Calculate
  - (a) Rated armature current
  - (b) Firing angle delay of the armature converter
  - (c) Speed regulation at rated load. [16]
- 7. Explain with block diagrams closed loop torque control and closed loop speed control of drives. [16]

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# Set No. 3

8. A 3 phase,400 V,50 Hz 4 pole,1400 rpm, Star connected Induction motor has the following parameters referred to the stator.

 $R_s = 2$  ohm,  $R_r' = 3$  ohm,  $X_s = 3.5$  ohm,  $X_r' = 3.5$ . The stator to rotor turns ratio is 2 ohm. The motor speed is controlled by Static Scherbius drive. The Inverter is directly connected to the source. Determine the firing angle for 0.4 times the rated motor torque and a speed of 1200 rpm. [16]

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