AQ–2888

Faculty of Engineering & Technology

M.E. Electrical (Electronics & Power) Engg. Semester—II (New-C.G.S.) Examination

POWER ELECTRONIC CONTROLLED DRIVES

(Elective—I)

Paper—2 EEPME 4

Time : Three Hours] [Maximum Marks : 80

INSTRUCTIONS TO CANDIDATES

(1) All questions carry marks as indicated.

(2) Due credit will be given to neatness and adequate dimensions.

(3) Assume suitable data wherever necessary.

(4) Illustrate your answers wherever necessary with the help of neat sketches.

(5) Use pen of Blue/Black ink/refill only for writing the answer book.

1. (a) Explain in detail four quadrant operation of a D.C. Motor drive. 7

(b) A 200 volt, 875 rpm, 150 Amp separately excited D.C. Motor has an Armature resistance of 0.06 Ω. It is fed from a single phase fully controlled rectifier with an A.C. source voltage of 220 volt, 50 Hz. Assuming continuous conduction. Calculate the firing angle for rated motor torque at 750 rpm. 7

OR

2. (a) Draw and explain the power circuit of semiconvertor feeding a separately excited D.C. Motor. Explain with typical voltage and current waveforms. 7

(b) A separately excited D.C. Motor has the following ratings and constants :

2.625 HP, 120 volt, 1313 rpm, R_a = 0.8 Ω, R_f = 100 Ω, K_p = 0.764 Vs/rad, L_a = 0.003 H, L_f = 2.2 H. The D.C. supply voltage is variable from 0 to 120 volt both

to the field and armature independently. Draw the torque-speed characteristics of the D.C. Motor if the armature and field currents are not allowed to exceed their rated value. The rated flux is obtained when the field voltage is 120 volt. Assume that the field voltage can be safely taken to a minimum of 12 volt only. 7

3. (a) Describe the steady state performance of chopper-controlled D.C. Motor drive with average values by neglecting harmonics. 6

(b) A separately excited D.C. Motor is controlled by a chopper whose input D.C. voltage is 180 volt. This motor is considered for low speed applications requiring less than 2% pulsating torque at 300 rpm.

(i) Evaluate its suitability for that application.

(ii) If it is found unsuitable, what is the chopping frequency that will bring the pulsating torque to the specification.

(iii) Alternatively a series inductor in the armature can be introduced to meet the specification. Determine the value of that inductor. The motor and chopper data are as follows :

3 HP, 120 volt, 1500 rpm, $R_a = 0.8\ \Omega$, $L_a = 0.003$ H, $K_a = 0.764$ v/rad/sec, $F_c = 500$ Hz. 7

OR

4. (a) With neat sketches and waveforms, explain the operation of four quadrant chopper circuit. 6

(b) The speed of separately excited D.C. Motor is controlled by a chopper. The supply voltage is 120 volt. Armature circuit resistance is 0.5 Ω, armature circuit inductance is 20 mH and motor constant is 0.05 v/rpm. The motor drives a constant load torque requiring an average current of 20 Amp. Assume motor current is continuous ; calculate :

(i) The range of speed control

(ii) The range of duty cycle. 7

5. (a) Explain slip-energy recovery scheme for Three Phase Induction Motor Drive. 6

(b) Compare Scherbius and Kramer drive system. Show that the scherbius drive can operate in the sub-synchronous and super synchronous range of operation. 7

OR

6. (a) Explain stator voltage control method of controlling the speed of Three Phase Induction Motor drive. 6

(b) Develop a flowchart for the computation of triggering angle versus conduction angle as a function of power factor angle. 7

SECTION—B

7. (a) Draw and describe speed-torque characteristics of variable voltage and variable frequency Induction Motor. 7

(b) Discuss with neat sketch the implementation of volts/Hz strategy for closed loop Induction Motor drive. 7

OR

8. (a) Draw circuit diagram of variable frequency Induction Motor Drive where no forced commutation of SCRs is required. Explain its working in detail. 7

(b) Explain with block diagram, the operation of a D.C. link voltage source inverter for speed control of Three Phase Induction Motor Drive. 7

9. (a) In what way speed control of A.C. Motors differs from that of D.C. Motors. Also explain what do you mean by vector control. 7

(b) Develop and explain flowchart for Indirect vector controlled Induction Motor. 6

OR

10. (a) Explain with block diagram the direct vector control scheme. 7

(b) Explain a current source indirect vector controller in detail. 6

11. (a) What are the different topologies for half wave operation of the PMBDCM drives. Explain any one. 7

(b) Write a short note on 'Design of current controllers for PMBDCM Drive'. 6

OR

12. (a) Discuss the merit and demerit of the PMBDC drive with split supply converter. 7

(b) Explain with block diagram, the speed controlled PMBDCM drive scheme without flux weakening. 6