Total No. of Questions : 12]

SEAT No. :

P2007

[Total No. of Pages : 4

[4759]-77
B.E. (Electrical)
INDUSTRIAL DRIVES AND CONTROL
(2008 Course) (Semester-II)

Time : 3 Hours] *[Max. Marks : 100*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***Answer any three questions from each section.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right side indicate full marks.***
5) ***Use of calculator is allowed.***
6) ***Assume suitable data if necessary.***

SECTION-I

Q1) a) A drive has the following parameters T = 100 – 0.1 N, N–m where N is the speed in rpm. Load torque T_l = 50, N-m. Initially the drive is operating in steady-state. The characteristic of the torque are changed to – 100 – 0.1 N, N-m. Calculate initial and final equilibrium speeds. For given drive also calculate the time from initial speed to final speed, if J = 10 kgm^2. **[8]**

b) Explain nature and classification of load torques. **[8]**

OR

Q2) a) Explain load equalization using flywheels in electrical drives. **[8]**

b) A motor is equipped with a flywheel to supply a load torque of 1000 Nm for 10 sec followed by a light load period of 200Nm long enough for flywheel to regain its steady state speed. It is desired to limit the motor load torque to 700 Nm. What should be moment of inertia of flywheel? Motor has inertia of 10 kg-m^2. Its no load speed is 500 rpm and slip at a torque of 500 Nm is 5%. Assume speed torque characteristic of motor to be straight line in the region of interest. **[8]**

P.T.O.

Q3) a) A 2 pole separately excited dc motor has the ratings of 220V, 100A and 750rpm. Resistance of the armature circuit is 0.1Ω. The motor has two field coils which are normally connected in parallel. It is used to drive a load whose torque is expressed as T_L = 500–0.3 N, N-m where N is the motor speed in rpm. **[8]**

i) Calculate the motor armature current and speed when armature voltage is reduced to 100V.

ii) Calculate the motor speed and current when two field coils are connected in series.

b) Explain plugging method for braking operation of following drive **[10]**

DC shunt motor.

OR

Q4) a) A 400V, star connected 3-phase 6-pole, 50Hz, induction motor has following parameters referred to stator: $R_s = R'_r = 1\Omega, X_s = X'_r = 2\Omega$ for regenerative braking operation of this motor determine: **[8]**

i) maximum overhauling torque it can hold and range of speed for safe operation.

ii) Speed at which it will hold an overhauling load with a torque of 100 N-m.

b) Explain dynamic method for braking operation with characteristic of following drives: **[10]**

i) DC shunt motor.

ii) Three phase induction motor.

Q5) a) Explain operation of chopper controlled DC series motor drive with suitable waveforms. **[8]**

b) A 220V, 1500 rpm, 50A separately excited DC motor has armature resistance 0.5Ω and assumes that motor is operating in continuous conduction mode. The motor is controlled by three phase fully controlled converter with source voltage of 440V, 50Hz. A star delta connected transformer is used to feed the armature so that motor terminal voltage equals rated voltage when converter firing angle is zero. **[8]**

i) Calculate transformer turns ratio.

ii) Determine when firing angle when a motor current is 1200 rpm and rated torque.

OR

Q6) a) Explain operation of three-phase fully controlled converter fed separately excited DC motor drive with suitable waveforms and derive relation between speed and firing angle. **[8]**

b) A 230V, 1000 rpm, 100A separately excited DC motor has armature resistance 1Ω and assumes that motor is operating in continuous conduction mode. The motor is controlled by single phase fully controlled converter with source voltage of 230V, 50Hz. Calculate motor torque:

[8]

i) At $\alpha = 30°$ and speed 900 rpm.

ii) At $\alpha = 120°$ and speed –900 rpm.

SECTION-II

Q7) a) A delta-connected squirrel cage induction motor has following ratings and parameters **[8]**

400V, 50Hz, 4-pole, 1420rpm,

$R_s = 0.35\Omega, R'_r = 0.4\Omega, X_s = 0.7\Omega, X'_r = 0.8\Omega$

The motor is fed from a voltage source inverter. The drive is operated with a constant v/f control up to 50Hz and at rated voltage above 50Hz. Calculate:

i) Frequency for motoring operation at 950 rpm and full load torque.

ii) Torque for frequency 40Hz and speed of 1100 rpm.

b) Explain closed loop control of CSI fed induction motor drives with neat block diagram. **[8]**

OR

Q8) a) A 400V, 50Hz, 4-pole, 1400rpm star-connected squirrel cage induction motor is fed from a voltage source inverter. The drive is operated with a constant v/f control form 10 to 50Hz. By assuming speed-torque curve for various frequencies to be parallel lines, calculate: **[8]**

i) Speed for frequency of 40Hz and 70% of full load torque.

ii) Frequency for a speed of 900 rpm and full load torque.

iii) Torque for frequency of 40Hz and speed of 1000 rpm as percentage of full load torque.

b) With neat diagram, explain $\frac{V}{f}$ =constant speed control method for induction motor. **[8]**

Q9) a) Explain static Sherbius based slip power recovery scheme for electrical drive. **[8]**

b) What are different losses in electrical drives and also enlist energy conservation measures. **[8]**

OR

Q10)a) Explain energy conservation using static rotor resistance control in induction motor. **[8]**

b) Explain components used for obtaining signals for interlocking and sequencing operations and protection. **[8]**

Q11)Write short note on: **[18]**

a) Flux oriented vector control of induction motor.

b) Electrical Drives in Sugar Mills.

c) Electrical Drives in Paper Mills.

OR

Q12)Write short note on: **[18]**

a) Commutatorless DC motor drive.

b) Electrical Drives in Traction.

c) Electrical Drives in Textile Mills.

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