15EE82

Eighth Semester B.E. Degree Examination, Jan./Feb. 2023
Industrial Drives and Applications

Time: 3 hrs.   Max. Marks: 80

Note: *Answer FIVE full questions, choosing ONE full question from each module.*

Module-1

1   a. With a neat diagram, explain four quadrant operator of a motor driving a hoist load. **(08 Marks)**

    b. A motor drives two loads, one has rotational motion and the other translational motion. Moment of inertia of motor is 1.2 kg.m^2. Motor runs at a speed of 1000 rpm. The load with rotational motion has on inertia of 7 kg.m^2 and a torque of 10N-m at a speed of 200rpm. The load with translational motion moves at a speed of 10 m/sec with the weight of 10 kg and a force of 20N. Calculate the equivalent inertia and torque of the system referred to the motor shift and power rating of the motor assuming negligible loss in the transmission system. **(08 Marks)**

OR

2   a. Obtain expression for equivalent load torque and equivalent at a motor drive with :
i) translational   ii) rotational motion loads. **(08 Marks)**

    b. A drive has the following parameters :
$J = 10$kg-m^2, $T = 100 - 0.1$ N N-m passive load-torque $T_\ell = 0.05$ N N-m, where N is the speed in rpm. Initially the drive is operating in steady-state. Now it is to be reversed. For this motor characteristics is altered such that $T = -0.15 - 0.01$ N N-m. Calculate the time of reversal.

(08 Marks)

Module-2

3   a. Explain the single phase fully controlled rectifier control of separately executed DC motor (Discontinuous conductor motor) **(10 Marks)**

    b. A constant speed drive has the following duty cycle :
(i) Load rising from 0 to 400 kW for 5 minutes
(ii) Uniform load of 500 kW for 5 minutes
(iii) Regenerative power of 400 kW returned to the supply for 4 minutes
(iv) Remains idle for 2 minutes
Estimate power rating of the motor. Assume losses to be proportional to (power)^2. **(06 Marks)**

OR

4   a. Explain the process of motoring and regenerative braking characteristics of a chopper control separately excited DC motor. **(08 Marks)**

    b. A 230V, 960rpm and 200A separately excited DC motor has an armature resistance of 0.02Ω. The motor is fed from a chopper which provides both motoring and braking operation. The source has a voltage of 230V. Assuming continuous conduction :
i)   Calculate the duty ratio of chopper for motoring operation at rated torque and 350 rpm
ii) Calculate the duty ratio of chopper for making operation at rated torque and 350 rpm
iii) If maximum duty ratio of chopper is limited to 0.95 and maximum permissible motor current is twice the rated current, calculate maximum permissible motor speed obtainable without field weakening and power fed to the source. **(08 Marks)**

Module-3

5 a. Explain the AC dynamic braking of 3 phase induction motor supplied from voltage source.
(08 Marks)

   b. Describe the operator of a 3 phase induction motor operating with unbalanced source voltages and single phasing. (08 Marks)

OR

6 a. Discuss the variable frequency control of a 3 phase induction motor supplied from voltage source. (08 Marks)

   b. A 400V, star connected 3 phase, 6 pole, 50 Hz induction motor has the following parameters referred to stator. $R_S = R_r' = 1\Omega$, $X_S = X_r' = 2\Omega$. For regenerative breaking operation calculate the maximum overhauling torque and range of speed for safe operation. (08 Marks)

Module-4

7 a. Explain the starting operation of a synchronous motor with damper winding from a fixed frequency supply. (08 Marks)

   b. Draw a block diagram and explain closed loop speed control of voltage source induction motor drive. (08 Marks)

OR

8 a. Explain the 3-phase induction motor fed from a variable frequency Current Source Inverter (CSI). What are the advantages and disadvantages remidial measures? (08 Marks)

   b. Explain two modes of variable frequency control of a synchronous motor. (08 Marks)

Module-5

9 a. With a neat diagram, explain brushless DC motor drive for servo application. (08 Marks)

   b. Explain the drive requirements for :
   i) Steel rolling mills
   ii) Cranes and Hoists. (08 Marks)

OR

10 a. Explain variable reluctance stepper motor. (08 Marks)

   b. With a neat diagram, explain the self controlled synchronous motor drive employing load commutated inverter. (08 Marks)

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