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

Time: 3 hrs.   Max. Marks: 100

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

Module-1

1   a. With the help of basic block diagram, explain the different parts of electrical drives system. **(08 Marks)**

     b. A motor equipped with a fly wheel is to supply a load torque of 1000N-m for 10sec followed by a light load period of 200N-m long enough for the flywheel to regain its steady-state speed. It is desired to limit the motor torque to 700N-m. What should be the moment of inertia of flywheel? Motor has an inertia of 10kg-m^2. What should be the moment of inertia of flywheel? Motor has an inertia of 10kg-m^2. Its no load speed is 500rpm and the slip at a torque of 500N-m is 5%. Assume speed-torque characteristic of motor to be a straight line in the region of interest. **(06 Marks)**

     c. Describe the operation of closed-loop toque control scheme and its application in battery powered vehicle or rail cars. **(06 Marks)**

OR

2   a. With the help of relevant sketches, explain the multi quadrant operation of drives and the four quadrant operation of a motor driving a hoist load. **(10 Marks)**

     b. Obtain expressions for equivalent moment of inertia and load torque of a motor drive with
i) Translational   ii) Rotational motion loads. **(10 Marks)**

Module-2

3   a. Obtain the thermal model of motor for heating and cooling. Also briefly explain heating and cooling curves. **(10 Marks)**

     b. Half hour rating of a motor is 100kW. Heating time constant is 80min and the maximum efficiency occurs at 70% full load. Determine the continuous rating of the motor. **(06 Marks)**

     c. A constant speed drive has the following duty cycle:
i)   Load rising from 0 to 400kW : 5 minutes
ii)   Uniform load of 500kW : 5 minutes
iii)   Regenerative power of 400kW returned to the supply : 4 minutes
iv)   Remains idle for : 2 minutes.
Estimate power rating of the motor. Assume losses to be proportional to (power)^2. **(04 Marks)**

OR

4   a. With the help of circuit diagrams and waveforms, explain the chopper control of separately excited dc shunt motor for
i)   Forward motoring and braking control
ii)   Dynamic braking. **(10 Marks)**

     b. A 200V, 875rpm, 150A separately excited dc motor has an armature resistance of 0.06Ω. It is fed from a single phase fully controlled rectifier with an ac source voltage of 220V, 50Hz. Assuming continuous conduction, calculate:
i)   Firing angle for rated motor torque and 750rpm
ii)   Firing angle for rated motor torque and (-500)rpm
iii)   Motor speed for $\alpha = 160°$ and rated torque. **(10 Marks)**

Module-3

5 a. Name the methods employed for braking of an Induction motor? Explain in brief regenerative braking. **(10 Marks)**

b. A 400V, star connected, 3-ϕ, 6-pole, 50Hz induction motor has following parameters referred to the stator: $R_s = R'_r = 1\Omega$, $X_s = X'_r = 2\Omega$. Motor is to be braked by plugging from its initial full speed of 950rpm. Stator to rotor turns ratio is 2.3.
   i) Calculate the initial braking current and torque as a ratio of their full load values.
   ii) What resistance must be inserted in rotor circuit to reduce the maximum braking current to 1.5 times full load current? What will be initial braking torque now? **(10 Marks)**

OR

6 a. Explain the effect of unbalanced voltages and single phasing on the induction motor performance. **(10 Marks)**

b. A 2200V, 2600kW, 735rpm, 50Hz, 8 pole, 3-ϕ squirrel-cage induction motor has following parameters referred to the stator: $R_s = 0.075\Omega_1$, $R'_r = 0.1\Omega$, $X_s = 0.45\Omega$, $X'_r = 0.55\Omega$. Stator winding is delta connected and consists of two sections connected in parallel.
   i) Calculate starting torque and maximum torque as a ratio of rated torque, if the motor is started by star-delta switching. What is the maximum value of line current during starting.
   ii) What will be the maximum value of line current and torque during starting, if the part winding method of starting is employed? **(10 Marks)**

Module-4

7 a. Explain the operation of voltage source inverter fed induction motor drives. Also sketch various schemes of VSI fed induction motor drive. **(10 Marks)**

b. Explain the closed loop speed control for VSI controlled 3 phase induction motor. **(10 Marks)**

OR

8 a. Explain the operation of current source inverter fed induction motor drive. Also sketch various schemes of CSI induction motor drives. **(10 Marks)**

b. With the help of block diagram, explain the operation of closed loop slip controlled CSI drive with regenerative braking. Also list out the advantages and disadvantages of CSI drives over VSI drives. **(10 Marks)**

Module-5

9 a. Explain the self controlled synchronous motor drive employing load commutated thyristor inverter. **(10 Marks)**

b. With the help of circuit diagram, explain the drive circuits used for stepper motors. **(10 Marks)**

OR

10 a. Explain the brushless dc motor drive for servo applications. **(10 Marks)**

b. Explain the drive requirements for i) Textile mills   ii) Steel rolling mills. **(10 Marks)**

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