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10EE74

Seventh Semester B.E. Degree Examination, June/July 2023

Industrial Drives and Applications

Time: 3 hrs. Max. Marks:100

Note: Answer any FIVE full questions, selecting at least TWO questions from each part.

PART – A

1 a. Mention the advantages of Electric drives. **(07 Marks)**

b. What is steady state stability in the drive system? Derive the required condition for stability. **(08 Marks)**

c. A motor equipped with a flywheel has to supply a load torque of 600 N-m for 10 sec followed by a no load period long enough for the flywheel to regain its full speed. The motor torque is limited to 450 N-m. What should be the moment of inertia of the flywheel? The no load speed of the motor is 600 rpm and it has a slip of 8% at torque of 400 N-m. Assume the motor speed-torque characteristic to be a straight line in the range of operation. Motor has an inertia of 10 kg-m^2. **(05 Marks)**

2 a. Explain the method of determination of motor rating for short time duty loads. Also mention the constraints 'K' is subjected. **(07 Marks)**

b. What are the disadvantages of using a motor of wrong rating? **(06 Marks)**

c. A motor has a continuous rating of 100 KW. The heating and cooling time constants are 50 and 70 min respectively. The motor has a maximum efficiency at 80% full load and is employed in an intermittent periodic load cycle consisting of a load period of 10 min followed by a no load period of 10 min. Calculate the value of the load in KW during the load period. **(07 Marks)**

3 a. Obtain the transient analysis of starting of a separately excited motor with armature control. **(10 Marks)**

b. A 220 V, 970 rpm, 100 A dc separately excited motor has an armature resistance of 0.1 Ω. It is braked by plugging from an initial speed of 1000 rpm. Calculate:

(i) Resistance to be placed in the armature circuit to limit braking current to twice the full load value

(ii) Braking Torque **(05 Marks)**

c. A 220V, 1500 rpm, 10A separately excited dc motor is fed from a single-phase fully controlled rectifier with an ac source voltage of 230 V, 50Hz. Armature resistance = 2Ω. Conduction can be assumed to be continuous. Calculate firing angle for half the rated motor torque at the speed is 500 rpm. **(05 Marks)**

4 a. Explain the operation of four quadrant dc drives employing non circulating and circulating current dual converters. **(09 Marks)**

b. Explain regenerative braking of a separately excited DC motor using chopper control. **(06 Marks)**

c. A 220V, 1500 rpm, 50 A separately excited motor with armature resistance of 1 Ω is fed from a 3 phase fully controlled rectifier. Available ac source has a line voltage of 440 V, 50 Hz. Determine the value of firing angle when motor is running at –800 rpm and twice the rated torque. 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. **(05 Marks)**

PART – B

5 a. Explain the effect of unbalanced rotor impedances on the induction motor performance. **(06 Marks)**

b. Explain AC dynamic braking with two lead connection of a wound rotor induction motor with neat diagram. **(08 Marks)**

c. A 2200 V, 50 Hz, 3-phase, 6-pole, Y-connected, squirrel cage induction motor has following parameters: $R_S = 0.055\ \Omega$, $R'_r = 0.12\ \Omega$, $X_S = X'_r = 0.5\Omega$. The combined inertia of motor and load is 100 kg-m^2. Calculate time taken and energy dissipated in the motor during starting. **(06 Marks)**

6 a. Explain the operating of VSI fed induction motor drives. **(06 Marks)**

b. Explain with the neat block diagram, the operation of current regulated voltage source inverter control. **(07 Marks)**

c. A 2.8 KW, 400 V, 50 Hz, 4 pole, 1370 rpm, delta connected squirrel-cage induction motor has following parameters referred to the stator: $R_S = 2\ \Omega$, $R'_r = 5\ \Omega$, $\alpha_S = X'_r = 5\ \Omega$, $X_m = 80\ \Omega$. Motor speed is controlled by stator voltage control. When driving a fan load it runs at rated speed at rated voltage. Calculate motor terminal voltage and torque at 1200 rpm. **(07 Marks)**

7 a. Why regenerative braking cannot be used for stopping or decelerating a load with an equivalent circuit? Explain dynamic braking of synchronous motor. **(06 Marks)**

b. With the block diagram, explain closed-loop speed control of load commutated inverter synchronous motor drive. **(06 Marks)**

c. A 3 MW, 3 phase, 11 KV, Y connected, 6 pole, 50 Hz, 0.8 (leading) power factor synchronous motor has $X_S = 9\ \Omega$ and $R_S = 0$. Rated field current is 50 A. Machine is controlled by variable frequency control at constant (v/f) ratio up to the base speed and at constant v above base speed. Determine torque and field current for regenerative braking operation at rated armature current, 1500 rpm and unity power factor. **(08 Marks)**

8 a. What are the requirements of paper machine drive? **(07 Marks)**

b. Discuss about the type of motors used for different textile processes. **(07 Marks)**

c. What is the process followed in continuous hot rolling mills and reversing cold rolling mills. **(06 Marks)**

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