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**Seventh Semester B.E. Degree Examination, Dec.09/Jan.10**

**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. Obtain the fundamental torque equations of a motor load system. (04 Marks)
  - b. Explain the speed torque conventions and multi-quadrant operations of a motor, driving a hoist load. (10 Marks)
  - c. A drive has the following parameters :  $J = 10 \text{ kg-m}^2$ ,  $T = 100 - 0.1N\text{-m}$ , passive load torque  $T_e = 0.05 \text{ N-Nm}$ , where  $N$  is the speed in rpm. Initially the drive is operating in steady state. Now it is to be reversed. For this, motor characteristic is changed to  $T = - 100 - 0.1 \text{ N-Nm}$ . Calculate the time of reversal. (06 Marks)
  
- 2
  - a. Develop the expression to determine power ratings of electric motors for the following application.
    - i) Continuous duty for fluctuating and intermittent loads by equivalent current, torque and power methods. (10 Marks)
  - b. Plot the load curve and select the proper motor rating for the following intermittent duty.
    - i)  $P_1 = 35 \text{ kW}$  for  $t_1 = 3 \text{ sec}$
    - ii)  $P_2 = 17 \text{ kW}$  for  $t_2 = 20 \text{ sec}$
    - iii)  $P_3 = 35 \text{ kW}$  for  $t_3 = 2 \text{ sec}$
    - iv)  $P_4 = 13 \text{ kW}$  for  $t_4 = 15 \text{ sec}$
 Between the operating periods (b) and (1) there is a pause ( $p = 0$ ) of  $t_{c1} = 37 \text{ sec}$ . At the end of the cycle there is another pause  $t_{c2} = 40 \text{ sec}$ . (06 Marks)
  - c. Explain the following classes of motor duty, with load diagrams :
    - i) Intermittent periodic duty with starting and braking.
    - ii) Continuous duty with intermittent periodic loading. (04 Marks)
  
- 3
  - a. Explain the regenerative and dynamic braking of D-C shunt motor, with diagrams. (06 Marks)
  - b. Describe the operation of single phase fully controlled rectifier control of d.c separately excited motor. (08 Marks)
  - c. A 220V, 970 rpm, 100 A d.c. separately excited motor has an armature resistance of  $0.05\Omega$ . It is braked by plugging from an initial speed of 1000 rpm. Calculate
    - i) Resistance to be placed in armature circuit to limit braking current to twice the full load value.
    - ii) Braking torque and
    - iii) Torque when the speed is fallen to zero. (06 Marks)
  
- 4
  - a. Explain the motoring control and regenerative braking of chopper control of separately excited d.c. motor. (10 Marks)
  - b. Explain the multi-quadrant operation of d.c. separately excited motor fed from fully controlled rectifier for the following schemes :
    - i) Single fully controlled rectifier with a reversing switch
    - ii) Dual converter. (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

## PART – B

- 5 a. Describe the operation of a three phase induction motor operating with unbalanced source voltages and single phasing. (08 Marks)
- b. A 500 V three phase 50 Hz, 8 pole, star connected induction motor has the following parameters of its equivalent circuit  $r_1 = 0.13\Omega$ ,  $r_2 = 0.32\Omega$ ,  $x_1 = 0.8\Omega$ ,  $x_2 = 1.48\Omega$ ,  $r_m = 250\Omega$ ,  $x_m = 20\Omega$ . The full load slip is 5%. The effective stator to rotor turns ratio per phase is 1/1.57. The machine is to be braked from full load speed by changing the stator connections and inserting an external rotor circuit resistance, which in primary terms is  $1.5\Omega$  per phase (referred to the stator). Determine the initial braking torque, when the stator is disconnected from the a.c. supply and d.c is fed into two of its terminals. Neglect mechanical losses and use the approximate equivalent circuit. (12 Marks)
- 6 a. Explain the dynamic braking and multiquadrant operation of voltage source inverter (VSI) induction motor drives. (10 Marks)
- b. Describe the speed control of three phase IM by static rotor resistance control. (10 Marks)
- 7 a. Obtain the dynamic torque equation for the synchronous motor drives and explain its regenerative braking. (10 Marks)
- b. Explain the self controlled synchronous motor drive employing load commutated thyristor inverter. (10 Marks)
- 8 a. Draw and explain the schematic diagram of various stages in the reversing hot rolling mills and mention the requirement of the drives. (10 Marks)
- b. Write the comparison between the line shaft drive and sectional drive of paper machine drives. (04 Marks)
- c. Classify the drives used in cement industry and explain briefly, any one of them. (06 Marks)

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