Seventh Semester B.E. Degree Examination, June/July 2016
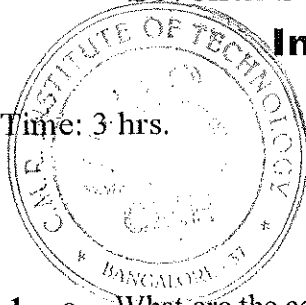## Industrial Drives and Applications

Time: 3 hrs.   Max. Marks:100

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

PART – A

1 a. What are the advantages of an electric drive system? (05 Marks)
   b. With a neat block diagram, explain the essential parts of electric drive. (05 Marks)
   c. With the help of the quadrantal diagram, explain the four-quadrant operation of a motor driving a hoist load. (10 Marks)

2 a. Calculate the starting time of a drive with following parameters $J = 10$ kg-mt^2, $T = 15 + 0.5 w_m$ and $T_L = 5 + 0.6 w_m$. (04 Marks)
   b. Explain the various classes of motors duty with load diagram. (08 Marks)
   c. Derive an expression for equivalent current I_{eq} for a fluctuating load. (04 Marks)
   d. The 10 min rating of a motor used in a domestic mixer is 200 Watts. The heating time constant is 40 min and the maximum efficiency occurs at full load (continuous). Determine the continuous rating. (04 Marks)

3 a. With speed-torque characteristics, explain the plugging operation of a separately excited DC motor. (06 Marks)
   b. With a neat circuit diagram and waveforms, explain the operation of discontinuous conduction mode for a single phase fully controlled rectifier of DC separately excited motor. (08 Marks)
   c. A 220 V, 1500 rpm, 10 A separately excited DC motor is fed from a single phase fully controlled rectifier with an AC source voltage of 230 V, 50 Hz, $R_a = 2\Omega$. Conduction can be assumed to be continuous. Calculate firing angles for:
      i) Half the rated motor torque and 500 rpm.
      ii) Rated motor torque and -1000 rpm. (06 Marks)

4 a. Explain the multi quadrant operation of separately excited DC motor fed from fully controlled rectifier for the following schemes:
      i) Single fully controlled rectifier with a reversing switch.
      ii) Dual converter. (08 Marks)
   b. Explain chopper control of separately excited DC motor for motoring control. (06 Marks)
   c. A 230 V, 960 rpm and 200 A separately excited DC motor has an armature resistance of 0.02Ω. The motor is fed from a chopper which provides both motoring and braking operations. The source has a voltage of 230 Volt. Assume continuous conduction mode:
      i) Calculate duty ratio of chopper for motoring operation at rated torque and 350 rpm.
      ii) Calculate duty ratio of chopper for braking operation at rated torque and 350 rpm. (06 Marks)

PART – B

5 a. Explain the operation of a 3-phase induction motor with unbalanced voltages. (06 Marks)
   b. Explain plugging of an induction motor. (06 Marks)

c. A 500 V, 3φ, 50 Hz, 8 pole, Y-connected induction motor has $R_1 = 0.13\ \Omega$, $R_2 = 0.32\ \Omega$, $X_1 = 0.6\ \Omega$, $X_2 = 1.48\ \Omega$, $R_0 = 250\ \Omega$, $X_0 = 20\ \Omega$. The full load slip is 5%. The effective stator to rotor turns ratio per phase is $\dfrac{1}{1.57}$. The machine is braked from full load speed by changing the stator connections and inserting an external rotor resistance, which in primary terms is 1.5 Ω/phase. Determine the initial braking torque, when the stator is disconnected from the AC supply and DC is fed into two of its terminals. **(08 Marks)**

6 a. Explain the static rotor resistance control. **(06 Marks)**
   b. Explain the static Kramer drive system. **(06 Marks)**
   c. A Y-connected squirrel cage induction motor has the following ratings and parameters: 400V, 50 Hz, 4 pole, 1370 rpm, $R_s = 2\Omega$, $R'_r = 3\Omega$, $X_S = X'_r = 3.5\ \Omega$, $X_m = 55\ \Omega$. It is controlled by a current source inverter at a constant flux. Calculate the motor torque, speed and stator current when operating at 30 Hz and rated slip speed. **(08 Marks)**

7 a. Explain pull-in process in synchronous motor operation from fixed frequency supply. **(05 Marks)**
   b. Explain the operation of a synchronous motor shifting from motoring to regenerative braking. **(05 Marks)**
   c. Explain the operation of self controlled synchronous motor drive employing load commutated thyristor inverter. **(10 Marks)**

8 a. Explain the operation of drives in paper mill. **(12 Marks)**
   b. Explain the operation of drives in a cement mill. **(08 Marks)**

* * * * *