Seventh Semester B.E. Degree Examination, Dec.2019/Jan.2020
Industrial Drives and Applications

Time: 3 hrs.   Max. Marks:100

Note: Answer FIVE full questions, selecting
atleast TWO questions from each part.

PART – A

1 a. What are the advantages of an electric drive system? **(04 Marks)**

  b. Explain the speed torque conventions and multiquadrant operations of a motor, driving a hoist load. **(10 Marks)**

  c. A derive has following parameters : $J = 10$kg-m^2, $T = 100 - 0.1N$, N-m, passive load torque $T_l = 0.05N$, 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 characteristic is changed to $T = -100 -0.1N$, N-m. Calculate the time of reversal. **(06 Marks)**

2 a. Develop the expression to determine power ratings of electric motors for, continuous duty fluctuating and intermittent loads by equivalent current, torque and power methods. **(10 Marks)**

  b. Explain the following classes of motor duty, with load diagrams.
     i) Intermittent periodic duty
     ii) Intermittent periodic duty with starting and braking. **(04 Marks)**

  c. A rolling mill driven by thyristor converted –fed DC motor operates on a speed reversing duty cycle. Motor field current is maintained constant at the rated value. Moment of inertia referred to the motors shaft is 10,000kg-m^2, duty cycle consists of the following intervals :
     i) Rolling at full speed (200rpm) and at a constant torque of 25,000N-m for 10sec
     ii) No load operation for 1sec at full speed
     iii) Speed reversal from 200 to –200rpm in 5sec
     iv) No load operation for 1sec at full speed.
     v) Rolling at full speed and at a torque of 20,000N-m for 15sec
     vi) No load operation at full speed for 1sec
     vii) Speed reversal from –200 to 200 rpm in 5 sec
     viii) No load operation at full speed for 1 sec
     Determine the torque and power ratings of the motor. **(06 Marks)**

3 a. With neat diagrams, explain the regenerative and dynamic braking of DC shunt motor. **(06 Marks)**

  b. With a neat circuit diagram and wave forms, explain the operation of discontinuous conduction mode for a single phase fully controlled rectifier of DC separately excited motor. **(10 Marks)**

  c. A 220v, 1500rpm, 50A separately excited motor with armature resistance of 0.5Ω, is fed from a 3-phase fully controlled rectifier. Available AC source has a line voltage of 440V, 50Hz. A star delta connected transformer is used to feed the armature so that motor terminal voltage equals rated voltage when converted firing angle is zero. Determine the value of firing angle when motor is running at 1200 rpm and rated torque. **(04 Marks)**

4 a. Explain the motoring control and regenerative braking of chopper control of separately excited DC motor. **(10 Marks)**

   b. Explain the multiquadrant operation of DC separately excited motor fed from fully controlled rectifier for the following schemes :
   i) Single fully–controlled rectifier with a reversing switch
   ii) Single fully controlled rectifier in the armature with field current reversal. **(10 Marks)**

PART – B

5 a. Explain the operation of a three phase induction motor operating with unbalanced source voltages and single phasing. **(10 Marks)**

   b. A 400V, star connected, 3-phse, 6-pole, 50Hz induction motor has following parameters referred to the stator : $R_S = R_r' = 1\Omega$, $X_S = X_r' = 2\Omega$. For regenerative braking operation of this motor determine :
   i) Maximum overhauling torque it can hold and range of speed for safe operation
   ii) Speed at which it will hold an overhauling load with a torque of 100N-m. **(10 Marks)**

6 a. Explain any three methods of starting of an induction motor. **(10 Marks)**

   b. A 440V, 50Hz, 970rpm, 6 pole, Y-connected, 3 phase wound rotor induction motor has following parameters referred to the stator $R_S = 0.1\Omega$, $R_r' = 0.08\Omega$, $X_S = 0.3\Omega$, $X_r' = 0.4\Omega$. The stator to rotor turns ratio is 2. Motor speed is controlled by static scherbius drive. Drive is designed for a speed range of 25% below the synchronous speed. Maximum value of firing angle is 165°. Calculate : i) transformer turns ratio ii) Torque for a speed of 780rpm and $\alpha = 140°$. **(10 Marks)**

7 a. With a neat circuit, explain the working of self-controlled synchronous motor drive employing load commutated thyristor inverter. **(10 Marks)**

   b. Explain the operation of a synchronous motor when fed from a fixed frequency supply. **(10 Marks)**

8 a. Draw and explain the schematic diagram of various stages in the reversing hot rolling mills. **(10 Marks)**

   b. With a neat sketch, explain paper mill drive system. **(10 Marks)**

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