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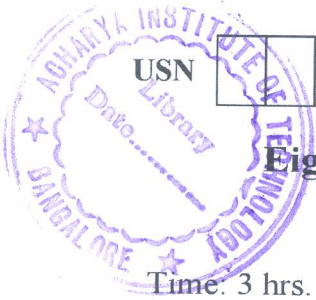
## Eighth Semester B.E. Degree Examination, July/August 2021
## Industrial Drives and Applications

Time: 3 hrs.                                                  Max. Marks: 80

*Note: Answer any FIVE full questions.*

1. a. Explain the different power modulators that are used in drive system. **(10 Marks)**
   b. A motor drives two loads. One has rotational motion. It is coupled to the motor through a reduction gear with a = 0.1 and efficiency of 90%. The load has a moment of inertia of 10kg-m² and a torque of 10N-m. Other load has translational motion and consists of 1000kg weight to be lifted up at an uniform speed of 1.5m/s. Coupling between this load and the motor has an efficiency of 85%. Motor has an inertia of 0.2kg-m² and runs at a constant speed of 1420RPM. Determine equivalent inertia referred to the motor shaft and power developed by the motor. **(06 Marks)**

2. a. Explain the speed-torque conventions and multi quadrant operation on a motor, driving a hoist load. **(08 Marks)**
   b. Mention the main factors which decide the choice of an electrical drive for a particular application. What is an electric drive? **(08 Marks)**

3. a. By assuming machine to be homogenous body, obtain the thermal model for heating and cooling of an electrical motor. **(08 Marks)**
   b. A motor has a heating time constant of 60min and cooling time constant of 90min, when run continuously on full load of 20kW, the final temperature rise is 40°C.
      i) What load motor can deliver for 10 min if this is followed by a shunt down period long enough for it to cool?
      ii) If it is on an intermittent load of 10min followed by 10min shut down, what is the maximum value of load it can supply during the ON load period?
      iii) Half hour rating of a motor is 100kW. Heating time constant is 80min and the max efficiency occurs at 70%FL. Determine the continuous rating of the motor. **(08 Marks)**

4. a. Explain the chopper control a separately excited dc motor. **(08 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-controller rectifier with an ac source voltage of 220V, 50Hz. Assuming continuous conduction, calculate.
      i) Firing angle for rated motor torque and 750rpm
      ii) Motor speed for α = 160° and rated torque
      iii) Motor torque for α = 60° and speed = 400rpm if armature inductance of motor drive of 0.85mH. **(08 Marks)**

5. a. Explain with relevant equations the operation of induction motor with unbalanced source voltage. **(08 Marks)**
   b. With a neat diagram, explain star-delta, auto transformer method of starting of three phase induction motor. **(08 Marks)**

6 a. Explain the variable frequency control of an induction motor and draw the speed-torque curves. **(08 Marks)**

   b. A 2200V, 50Hz, 3-phase, 6 pole, Y-connected, squirrel cage induction motor has following parameters: $R_s = 0.075\Omega$, $R_r^1 = 0.12\Omega$, $X_s = X_r^1 = 0.5\Omega$. The combined inertia of motor and load is 100kg-m$^2$

     i) Calculate time taken and energy dissipated in the motor during starting.

     ii) Calculate time taken and energy dissipated in the motor when it is stopped by plugging. **(08 Marks)**

7 a. What are the relative advantages and disadvantages of CSI and VSI drives? **(06 Marks)**

   b. A Y-connected squirrel cage induction motor has following ratings and parameters:

    400V, 50Hz, 4pole, 1370rpm, $R_s = 2\Omega$, $R_r^1 = 3\Omega$, $X_s = X_r^1 = 3.5\Omega$

    Motor is controlled by a voltage source inverter at constant v/f ratio. For regenerative braking operation of inverter-fed induction motor drive. Determine approximate values of:

     i) Speed for the frequency of 30Hz and 80% of full load torque.

     ii) Frequency for a speed of 1000rpm and full load torque.

     iii) Torque for a frequency of 40Hz and speed of 1300rpm.

     iv) Calculate motor break down torque for inverter fed induction motor drive for a frequency of 60Hz as a ratio of its value at 50Hz. **(10 Marks)**

8 a. With circuit diagram and speed-torque curves explain the operation of static scherbius drive for slip power recovery scheme. **(06 Marks)**

   b. A 1-phase, 220V, 50Hz, 1425rpm induction motor has following parameters: Rs = 2$\Omega$, $R_r^1 = 5\Omega$, $X_s = X_r^1 = 6\Omega$ and $X_m = 60\Omega$. It drives a fan load at rated speed when full voltage is applied. Motor speed is controlled by the stator voltage control. Calculate the motor terminal voltage for a speed of 1200rpm. **(10 Marks)**

9 a. Explain with block diagram, closed loop speed control of load commutated inverter synchronous motor drive. **(08 Marks)**

   b. Draw the block diagram of variable frequency control of multiple synchronous motor and explain. **(08 Marks)**

10 a. Explain permanent magnet type stepper motor. **(08 Marks)**

   b. Explain the various stages in textile mill and motors used in various stages. **(08 Marks)**

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