UJ – 103

VI Semester B.E. (E & E) Degree Examination, June/July 2016
(2K11 Scheme)
EE – 603 : ELECTRIC DRIVES

Time : 3 Hours Max. Marks : 100

Instruction : *Answer* ***any five full*** *questions choosing atleast* ***two*** *from* ***each*** *Part.*

PART – A

1. a) Explain with the help of a block diagram, the basic elements of an electric drive. **6**

   b) Explain what do you understand by the steady-state stability. Derive the condition for steady-state stability of a drive system. **8**

   c) Explain the components of load torque. **6**

2. a) Explain the operation of a single-phase fully-controlled rectifier-fed dc separately excited motor. Assume continuous conduction mode. **10**

   b) A 230 V, 960 rpm and 200A 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 V. Assuming continuous conduction. **6**

      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.

   c) Describe the relative merits and demerits of four quadrant dc drives employing non-circulating and circulating current dual converters. **4**

3. a) Explain the closed-loop speed control scheme for controlling the speed of a dc separately excited dc motor for control below and above base speed. **10**

   b) A 3 phase, 440 V, 6 pole, 970 rpm, 50 Hz, Y-connected induction motor has the following parameters referred to the stator

   $R_s = 0.2\ \Omega$, $R'_s = 0.15\ \Omega$, $X_s = X'_r = 0.4\ \Omega$.

   The stator to rotor turns ratio is 3.5.The motor speed is controlled by static Scherbius drive. The drive is designed for a speed range of 30% below the synchronous speed. The maximum value of firing angle is 170°. Calculate

   i) Turns ratio of the transformer.

   ii) Torque for a speed of 750 rpm and $\alpha = 140°$.

   iii) Firing angle for half the rated motor torque and a speed of 850 rpm. **10**

4. a) Explain stator voltage control of three phase induction motor. **7**

   b) For variable frequency control of induction motor explain the following points. **4**

   i) For speeds below base speed (v/f) ratio is maintained constant.

   ii) For speeds above base speed, the terminal voltage is maintained constant.

   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 : **9**

   $R_s = 2\ \Omega$, $R'_r = 5\ \Omega$, $X_s = X'_r = 5\ \Omega$, $X_m = 80\ \Omega$. Motor speed is controlled by stator voltage control. When driving a fan load it runs at rated speed at rated voltage. Calculate

   i) motor terminal voltage, current and torque at 1200 rpm

   ii) motor speed, current and torque for the terminal voltage of 300 V.

PART – B

5. a) Explain the construction and working principle of Permanent Magnet Synchronous Motor (PMSM). **12**

   b) Explain the construction and working of stepper motor. **8**

6. a) Explain the thermal model of an electric motor for heating and cooling. **12**

   b) Explain the considerations in selecting a motor drive for steel rolling mill. **8**

7. a) Explain the construction and principle of operation of a switched reluctance motor. **10**

   b) A motor has a continuous rating of 100 kW. The heating and cooling time constants are 50 and 70 mins, respectively. The motor has a maximum efficiency of 80% full load and is employed in an intermittent periodic load cycle consisting of a load period of 10 mins. Calculate the value of the load in kW during the load period. **6**

   c) Compare the merits and demerits of VSI and CSI fed drives. **4**

8. a) Describe self-controlled and load commutated inverter controlled synchronous motor drives in detail and compare them. **10**

   b) Explain the operation of BLDC motor drive. **10**