

**Elective – III : Power Semiconductor Based Drives**

P. Pages : 2

TKN/KS/16/7662

Time : Three Hours



Max. Marks : 80

- Notes :
1. All questions carry marks as indicated.
  2. Solve Question 1 OR Questions No. 2.
  3. Solve Question 3 OR Questions No. 4.
  4. Solve Question 5 OR Questions No. 6.
  5. Solve Question 7 OR Questions No. 8.
  6. Solve Question 9 OR Questions No. 10.
  7. Solve Question 11 OR Questions No. 12.
  8. Assume suitable data whenever necessary.
  9. Illustrate your answers whenever necessary with the help of neat sketches.
  10. Use of non programmable calculator is permitted.

1. a) Derive the condition for steady state stability for motor load system. 7  
 b) A drive has the following equations for motor and load torques. 7  
 $T_M = (-1 - 2\omega m)$  and  $T_L = -4\sqrt{\omega m}$   
 Obtain the equilibrium points and determine their steady state stability.  

**OR**
  2. a) What are the various operating modes of electrical drives ? Explain how the following speed transition is carried out. 7  
 i) Acceleration in same direction      ii) Deceleration in same direction  
 iii) Speed Reversal  
 b) A motor is used to drive a hoist Motor characteristics are given by 7  
 Quadrants I, II and IV :-  $T = 200 - 0.2N$ , N-M  
 Quadrants II, III and IV :-  $T = -200 - 0.2N$ , N-M  
 When hoist is load the net torque  
 $T_L = 100$  N-m and when it is unloaded net torque  $T_L = -80$  N-m obtain the equilibrium speeds for operation in all the four quadrants.
  3. a) Explain the single phase Fully Controlled Rectifier control of dc separately excited motor. Describe its operation in continuous as well as in discontinuous mode. 7  
 b) A 220V, 1500rpm, 50A separately excited motor with armature resistance of  $0.5\Omega$  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 converter firing angle is zero. 6  
 i) Calculate transformer turns ratio  
 ii) Determine the value of firing angle when  
 a) Motor is running at 1200rpm and rated torque  
 b) Motor is running at -800rpm and twice the rated torque
- OR**
4. a) Explain in brief chopper control of separately excited dc motor. Also explain its operation in Regenerative Braking Mode. 7  
 b) A 230V, 960rpm and 200A separately excited dc motor has an armature resistance of  $0.02\Omega$ . The motor is fed from a chopper which provides both motoring and braking operations. The source has a voltage of 230V. Assume continuous conduction. 6  
 i) Calculate duty ratio of Chopper for motoring operation at rated torque and 350rpm  
 ii) Calculate duty ratio of chopper for braking operation at rated torque and 350rpm.

- iii) If maximum duty ratio of chopper is limited to 0.95 and maximum permissible motor current is twice the rated calculate maximum permissible motor speed obtainable without field weakening.
5. a) Explain slip power Recovery scheme and explain static scherbius drive. 7  
 b) Explain the working of 3 phase half wave cycloconverter fed induction motor drive. 6
- OR**
6. a) Explain the basic concept of vector control of 3-phase induction motor. 7  
 b) Explain in brief with circuit diagram the working of current source inverter (CSI) fed induction motor drive. 6
7. a) Explain True synchronous and self controlled mode of operation of synchronous motor Drive. 7  
 b) A 500kw, 3phase, 3.3KV, 50Hz, 0.8 (lagging) power factor, 4 pole, star connected synchronous motor has following parameters:  $X_S = 15\Omega$   $R_S = 0$ . Rated field current is 10A.  
 Calculate  
 i) Armature current and power factor at half the rated torque and rated field current  
 ii) Field current to get unity power factor at the rated torque  
 iii) Torque for unity power factor operation at field current of 12.5A. 6
- OR**
8. a) Explain with neat circuit diagram the working of self controlled synchronous motor Drive using hood commutated inverter. 7  
 b) Explain in detail synchronous motor Drive using cycloconverter. 6
9. a) Explain the principle of operation of a stepper motor what is micro stepping ? Give advantages and disadvantages of stepper motor. 7  
 b) Explain the working of converter circuit for switched Reluctance Motor. 6
- OR**
10. a) Explain Battery Powered Vehicle. 7  
 b) Why Energy conservation is important in Electrical Drives ? List the measures that could be taken to conserve Energy in Electrical drives. 6
11. a) Explain dc traction using semiconductor chopper controlled dc motor with composite braking. Give the advantages of chopper control over Resistance control dc traction. 7  
 b) Explain the operation of dc traction drive using PWM voltage source inverter (VSI) induction motor Drive. How composite Braking is Carried out ? 7
- OR**
12. a) Explain 25KV ac Traction. Drive using a Thyristor semiconductor controlled. Converter feeding four separately excited dc motors ? Why a converter with two stage control is used? 7  
 b) Explain 25KV, 50Hz ac traction drive using ON Load Transformer Tap changer what are its advantages and disadvantages ? 7

\*\*\*\*\*