

**Elective - III : Power Semiconductor Based Electric Drives**

P. Pages : 2

Time : Three Hours



**NKT/KS/17/7577**

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. Due credit will be given to neatness and adequate dimensions.
  9. Assume suitable data whenever necessary.
  10. Illustrate your answers whenever necessary with the help of neat sketches.

1. a) With the help of equivalent Motor load system, explain dynamics of electric drive. What is the role of dynamic torque. 7

b) What are the various operating modes of electric drive? Draw suitable diagram. 7

**OR**

2. a) What is mean by stability of electric drive. Explain the stability consideration in with reference to point ABCD. 7

b) Write a short note on four quadrant operation of electric drive. 7

3. a) Explain in brief Chopper control of SEDC motor. 6

b) A 200V, 875 RPM, 150 A SEDC motor has an armature resistance of  $0.06 \Omega$ . It is fed from a single phase fully controlled rectifier with AC source voltage of 220V, 50Hz.

Assuming continuous current operation, calculate :

i) Firing angle for rated torque & 150 rpm

ii) Firing angle for rated torque & 500 rpm

iii) Motor speed for  $\alpha = 160^\circ$  and rated torque.

**OR**

4. a) Write a short note on dual - converter drive. 6

b) Explain in brief about the phase controlled rectifier which fed D.C. motor. 7

5. a) What do you mean by 'slip power' ? Explain any method employed in control drive by utilizing this power. 7

b) A 3phase, 400V, 50 Hz, 10 kw, 960 rpm. 6 pole star connected slip ring induction motor has the following constants referred to the stator :

$$R_S = 0.4 \text{ ohm}, R_r' = 0.6 \text{ ohm}, X_S = X_r' = 1.4 \text{ ohm}$$

The motor drives a fan load at 960 r.p.m. The stator to rotor turns ratio is 2.

What resistance must be connected in each phase of the rotor circuit to reduce the speed to 800 r.p.m. ?

**OR**

6. a) Explain with neat diagrams, voltage source inverter fed induction motor drive. Also draw the related waveforms. 7
- b) A 2.8 kw, 400 V, 50 Hz, 4 pole, 1370 rpm, delta connected squirrel cage induction motor has following parameter referred to the stator : 7  
 $R_S = 2\Omega$ ,  $R_r' = 5\Omega$ ,  $X_S = X_r' = 5\Omega$ ,  $X_m = 80\Omega$   
 Motor speed is controlled by stator voltage control. When driving a fan load it runs at rated speed and rated voltage calculate :  
 i) Motor terminal voltage, current and torque at 1200 rpm and  
 ii) Motor speed, current and torque for the terminal voltage of 300V.

7. a) Explain the difference between true synchronous and self controlled mode of operating of synchronous motor drive. 6
- b) Explain in brief voltage source inverter fed synchronous motor drive. What are the main features of VSI fed synchronous motor drive ? 7

**OR**

8. a) Explain the operation of the synchronous motor as a variable speed drive in self controlled mode, controlled by load commutated inverter. 6
- b) A 6 mw, 3-phase, 11 kv, Y connected, 6-pole, 50 Hz, 0.9 (leading) power factor synchronous motor has  $X_S = 9\Omega$  and  $R_S = 0$ . Rated field current is 50A. 7  
 Machine is controlled by variable frequency control at constant (V/f) ratio upto the base speed and at constant V above base speed. Determine  
 i) Torque and field current for the rated armature current, 750 rpm and 0.8 leading power factor.  
 ii) Armature current and power factor for half the rated motor torque, 1500 rpm and rated field current.

9. a) Explain the principle of operation of a Brushless DC Motor. Draw suitable converter circuit for the Brushless DC motor and the relevant waveforms. 7
- b) Compare switched reluctance motor with synchronous motor and stepper motor. 6

10. a) Classify stepper motors. Explain it's working principle with suitable diagram what are their main features. 7

- b) Write short note on solar powered drive. 6

11. a) Explain in brief 25 kv ac traction using transformer with tap changer. 7

- b) State the advantages of chopper control over resistance control in a DC traction. 6

**OR**

12. a) Explain the operation of AC traction drive using PWM voltage source inverter induction motor drive with a provision of dynamic braking. 7

- b) Write short note on ac traction employing polyphase ac motors. 6

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