Reg. No. | | | | | | | | | | | | |

Question Paper Code : 87055

M.E. DEGREE EXAMINATION, MAY/JUNE 2016

Second Semester

Power Electronics and Drives

PX 7202 – SOLID STATE AC DRIVES

(Regulations 2013)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. What are the advantages of electric drives ?

2. Where is the V/f control used ?

3. Mention the advantages of PWM inverter.

4. What are the advantages of CSI Fed drive ?

5. State how the voltage is injected in the rotor circuit ?

6. Write the advantages of static rotor resistance control.

7. What is indirect flux control ?

8. What are the advantages of field oriented control of induction motor ?

9. Define about brushless excitation method.

10. What do you mean by hunting oscillations and where it will be occurred ?

PART – B (5 × 13 = 65 Marks)

11. (a) Derive the steady state per phase equivalent circuit of Induction motor with suitable mathematical expressions and also draw the performance characteristics. **(13)**

OR

(b) (i) Describe any two methods of electric braking for induction motor. **(8)**

(ii) A 1-phase, 220 V, 50 Hz, 1425 rpm induction motor has following parameters : $R_s = 2\Omega$, $R'_r = 5\Omega$, $X_s = X_r = 6\Omega$, it drives a fan load at rated speed when full voltage is applied. The motor speed is controlled by the stator voltage control. Calculate the motor terminal voltage for a speed of 1200 rpm. **(5)**

12. (a) (i) A three phase, star connected 60 Hz, 4 pole induction motor has the following parameters for its equivalent circuit. $R_s = R_r = 0.024$ and $X_z = X_r = 0.12$. The motor is controlled by the variable frequency control with a constant (v/f) ratio. For an operating frequency of 12 Hz. Calculate :

(1) The breakdown torque as a ratio of its value at the rated frequency for both monitoring and braking.

(2) The starting torque and rotor current in terms of their values at the rated frequency. **(8)**

(ii) Explain the voltage source inverter (VSI) fed induction motors drive operated as stepped wave inverter. **(5)**

OR

(b) Explain the working of closed loop variable frequency PWM inverter with dynamic braking operation. **(13)**

13. (a) Explain the principle of operation of static Scherbius system. **(13)**

OR

(b) Discuss about the modified Kramer drives. **(13)**

14. (a) (i) Explain about dc drive analogy of Induction motor. **(8)**

(ii) Describe the indirect vector control technique. **(5)**

OR

(b) Explain the direct torque control technique. **(13)**

15. (a) Explain the starting and braking schemes of synchronous motors. **(13)**

OR

(b) Describe the operation of load commutated synchronous motor drive. **(13)**

PART – C (15 × 1 = 15 Marks)

16. (a) A three-phase, 50 Hz, star-connected, 970 rpm, 6-pole induction motor has the following parameter $R_s = 0.2\ \Omega$, $R_r' = 0.15\ \Omega$, $X_s' = X_r = 0.4\ \Omega$. The stator to rotor terms ratio is 3.5. The motor is controlled by the static Kramer drive. The driver is designed for a speed range of 30% below the synchronous speed. The maximum value of firing angle is 170°. Calculate the following :

(i) The turns ratio of the transformer.

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

(iii) The firing angle for half the rated motor torque and a speed of 850 rpm.

OR

(b) A 3 phase 400 V, 50 Hz, 6 pole star connected round-rotor synchronous motor has $Zs = 0 + j2\Omega$. Load torque, proportional to speed squared, is 340 N-m at rated synchronous speed. The speed of the motor is lowered by keeping v/f constant and maintaining unity power factor by field control of the motor. For the motor operation at 600 rpm, calculate

(i) Supply voltage

(ii) armature current

(iii) excitation angle

(iv) load angle

(v) the pull-out torque

Neglect rotational losses.