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Question Paper Code : 20522

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2022.

Sixth Semester

Electrical and Electronics Engineering

EE 8601 – SOLID STATE DRIVES

(Regulations 2017)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Draw the block diagram of electric drive.

2. Mention the different factors for the selection of electric drives?

3. What are the advantages in operating choppers at high frequency?

4. A DC motor has an armature current of 110 A at 480 V. The armature resistance is 0.2 ohms. The motor has 6 poles and armature has a lap winding with 864 conductors. The flux per pole is 0.05 Wb. Find speed and torque.

5. Draw the complete speed-torque curve of an induction machine.

6. Compare static kramer and static scherbius drive system.

7. In variable frequency control of synchronous motor, V/F ratio is maintained constant up to base speed, why?

8. What are the modes of speed control of a synchronous motor?

9. What are the advantages of using PI controller in closed loop control of DC drive?

10. What is field weakening mode control?

PART B — (5 × 13 = 65 marks)

11. (a) (i) An electric motor has a rotational load directly connected to its shaft. The torque speed characteristics of motor and load are:

$T = 0.6 + 1.9\omega_m$ and $T_L = 2.8\sqrt{\omega_m}$. (9)

(ii) A motor operates continuously on the following duty cycle; 50 hp for 20 seconds, 100 hp for 20 seconds, 150 hp for 10 seconds, 120 hp for 20 seconds and idle for 15 seconds. Find proper size of motor. (4)

Or

(b) (i) Describe the four-quadrant operation of an electric motor driving a hoist load. (8)

(ii) Explain the joint speed-torque characteristics of three phase induction motor with respect to (1) constant torque loads (2) fan type loads. (5)

12. (a) (i) A separately excited DC motor operating from a single-phase half-controlled bridge at a speed of 1500 rpm has an input voltage of 300 sin 314t and a back emf 80 V. The SCRs are fired symmetrically at α = 30 deg in every half cycle and the armature has a resistance of 5Ω. Calculate the average armature current and the motor torque. (6)

(ii) Describe the single-phase fully controlled converter fed separately excited DC motor drive in continuous conduction mode and obtain the expression for motor speed. (7)

Or

(b) (i) The chopper used for ON-OFF control of a DC separately excited motor has supply voltage of 230V dc., an on-time of 10 m-sec and off-time of 15m-sec. Neglecting armature inductance and assuming continuous conduction of motor current, calculate the average load current when the motor speed is 1500 rpm and has voltage constant of K_v = 0.5 V/rad/sec. The armature resistance is 3Ω. (7)

(ii) Describe the working of single quadrant chopper fed DC separately excited motor drive and obtain the expression of average output voltage. (6)

13. (a) (i) Discuss briefly the stator voltage control scheme of induction motor. Also draw the speed torque curves for different voltages. (7)

(ii) Explain the speed control of slip ring induction motor using rotor resistance control. (6)

Or

(b) (i) Draw the circuit diagram and explain the working of slip power recovery scheme using solid state scherbius system. (9)

(ii) What is meant by vector control scheme of an induction motor? (4)

14. (a) (i) Describe the self-controlled synchronous motor drive in detail and compare with true synchronous mode of control. (9)

(ii) Explain the power factor control of synchronous motor drive with relevant vector diagrams. (4)

Or

(b) Explain the operation of synchronous motor drive using three phase voltage source inverter and current source inverter. Draw the necessary waveforms. (13)

15. (a) Derive the transfer function of separately excited DC motor and load system with armature voltage control. (13)

Or

(b) (i) Explain in detail about converter selection and characteristics. (5)

(ii) Draw the circuit diagram and explain the operation of closed loop control with inner current loop system. (8)

PART C — (1 × 15 = 15 marks)

16. (a) (i) Derive the transfer function of the speed controller. (5)

(ii) Show that the no-load speed of the induction motor in the kramer drive can be varied from near standstill to full speed as the firing angle α is varied from almost 180 deg to 90 deg. (10)

Or

(b) A motor is used to drive a hoist. Motor characteristics are given as follows:

Quadrants I, II and IV :T = 200 -0.2N, N-m.
Quadrants II, III and IV: T -200 -0.2N, N-m.

Where N is the speed in rpm. When hoist is loaded, the net load torque, T_L = 100 N-m and when it's unloaded, the net load torque, T_L = -80 N-m. Obtain the equilibrium speeds for operation in all four quadrants. (15)

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