

**C 3223**

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Sixth Semester

(Regulation 2004)

Electrical and Electronics Engineering

EE 1351 — SOLID STATE DRIVES

(Common to B.E. (Part-Time) Fifth Semester Regulation — 2005)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are all the components of Load torque?
2. What are all the conditions to be satisfied for the regenerative braking operation to take place?
3. When is discontinuous conduction mode expected with the operation of converter fed dc drives?
4. Explain whether discontinuous conduction will occur in the operation of chopper fed dc drives?
5. State the advantages of PI controller used in closed loop control of induction motor drives.
6. Compare voltage source and current source inverter fed drives.
7. Mention any two advantages of self control of synchronous motor.
8. Write down the Torque equation of synchronous motor.
9. List out the factors concerned with selection of converters.
10. What are the advantages of closed loop speed control?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Derive the mathematical condition for steady state stability of equilibrium point. (8)
- (ii) Based on the mathematical condition, examine the stability of equilibrium points A, B, C & D given in figures(1) & (2). (8)

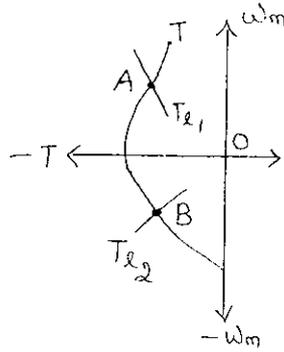


Fig. (1)

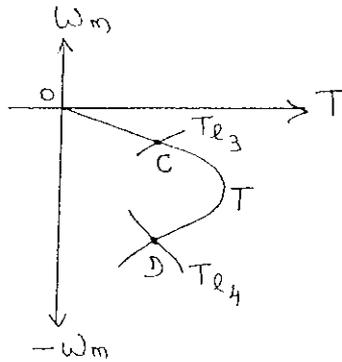


Fig. (2)

Or

- (b) (i) Explain in detail the multi quadrant dynamics in the speed-torque plane. (8)
- (ii) A motor drives two loads. One has rotational motion. It is coupled to the motor through a reduction gear with a = 0.1 and efficiency of 90 %. The load has a moment of inertia of 10 kg-m<sup>2</sup> and a torque of 10 N-m. The other load has translational motion and consists of 1000 kg weight to be lifted up at a uniform speed of 1.5 m/sec. Coupling between this load and the motor has an efficiency of 85%. Motor has an inertia of 0.2 kg-m<sup>2</sup> and runs at a constant speed of 1420 r.p.m. Determine the equivalent inertia referred to the motor shaft and power delivered by the motor. (8)
12. (a) Explain in detail the operation and steady state analysis of 1 phase fully controlled converter fed dc drive with neat waveforms in continuous and discontinuous conduction modes. (16)

Or

- (b) (i) Explain the operation of four quadrant chopper control in dc motor drives. (8)
- (ii) A 250 V separately excited dc motor has an armature resistance of  $2.5 \Omega$ . When driving a load at 600 r.p.m. with constant torque, the armature takes 20 A. This motor is controlled by a chopper circuit with a frequency of 400 Hz and an input voltage of 250 V.
- (1) What should be the value of the duty ratio if one desires to reduce the speed from 600 to 540 r.p.m. with the load torque maintained constant.
- (2) Find out the value of duty ratio for which the per unit ripple current will be maximum. (8)

13. (a) Explain in detail with suitable diagrams and waveforms the (v/f) control applied to induction motor drives. (16)

Or

- (b) (i) Explain with neat diagram and equations the static Scherbius system of slip power recovery scheme. (8)
- (ii) A 3 phase, star connected, 60Hz, 4 pole induction motor has the following parameters for its equivalent circuit.  $R_s = R_r = 0.024 \Omega$  and  $X_s = X_r = 0.12 \Omega$ . 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 it's value at the rated frequency for both motoring and braking.
- (2) The starting torque and rotor current in terms of their values at the rated frequency. (8)

14. (a) (i) Explain open loop speed control of synchronous motor with constant (v/f) ratio. (8)
- (ii) Explain power factor control of synchronous motor with relevant vector diagram. (8)

Or

- (b) (i) Explain self control of synchronous motor in detail. (8)
- (ii) Write short notes on permanent magnet synchronous motor. (8)
15. (a) (i) Derive the transfer function of dc motor-load system. (8)
- (ii) Give the design procedure of current controller. (8)

Or

- (b) Explain the armature voltage control of dc motor with constant field and field weakening modes. (16)