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B.E/ B.Tech. DEGREE END SEMESTER EXAMINATIONS, NOV 2011

ELECTRICAL AND ELECTRONICS ENGINEERING BRANCH

SEVENTH SEMESTER

EE 9401-SOLID STATE DRIVES

Time : 3 hr (REGULATIONS 2008) Max Marks: 100

Answer ALL Questions

Part –A (10 X 2 = 20 Marks)

1. A drive has the following parameters: T=150-0.1N, N-m, where N is the speed in rpm. Load torque T_l = 100, N-m. Initially the drive is operating in steady-state. The characteristics of the load torque are changed to T_l = 100, N-m. Calculate initial and final equilibrium speeds.
2. What are the components of load torques?
3. How regenerative braking is achieved in fully controlled rectifier fed dc drive?
4. Draw a class of chopper capable of driving the motor in forward motoring and braking operation.
5. When operating in regenerative braking, why is the induction motor slip should not be allowed to exceed the breakdown slip?
6. State the drawbacks of an induction motor fed from a stepped wave inverter.
7. Why a self-controlled synchronous motor is free from hunting oscillations?
8. What are the advantages of permanent magnet synchronous motor?
9. How will you select the rating of power switches used in the converter from the motor load specifications?
10. Write the transfer function of converter Gr(s).

Part –B(5 X 16 = 80 Marks)

11. a. i. State and prove the mathematical condition for steady state stability. **(6)**

ii. A motor having a suitable control circuit develops a torque given by the relationship Tm=aw+b. The motor is used to drive a load $T_L=cw^2+d$ where a, b, c, d are positive constants. The total inertia of the rotating masses is J.

(a) Determine the relations amongst the constants such that the motor can start together with the load and have an equilibrium operating point?
(b) Calculate the equilibrium speed?
(c) Will the drive be stable at this speed?
(d) Determine the initial and maximum acceleration of the drive? **(10)**

12. a. A 220V, 1200rpm 15A separately excited motor has armature resistance and inductance of 1.8Ω and 32mH respectively. This motor is controlled by a single-phase fully controlled rectifier with an ac source voltage of 230V, 50Hz. Identify the modes and

i. Calculate developed torques for: $\alpha = 60°$ and speed = 450rpm

ii. Calculate speed for:$\alpha = 45°$ and torque = 40N-m.

(OR)

12. b. i. A 230V, 1200 rpm,15 A separately excited dc motor has an armature resistance of 1.2Ω is now operated in dynamic braking with chopper control with a braking resistance of 20 Ω.

(a) Calculate duty ratio of chopper for a motor speed of 1000rpm and braking torque of 1.5 times the rated motor torque.

(b) What will be the motor speed for a duty ratio 0.5 and motor torque equal to its rated torque? **(8)**

ii. Discuss the motoring and regenerative braking operation of separately excited motor using chopper control. **(8)**

13. a. i. Discuss in detail, the different drive operating regions of torque speed curves and induction motor characteristics in constant torque and field weakening regions. **(8)**

ii. A star connected squirrel-cage induction motor has following ratings and parameters: 400V, 50 Hz,4-pole,1370 rpm, Rs=2Ω, R'r=3Ω, Xs=X'r=3.5Ω. For regenerative braking operation when fed from the inverter, determine the values of

(i) Speed for the frequency of 30 Hz and 80% of full load torque

(ii) Frequency for a speed of 1000 rpm and full load torque.

(iii) Torque for a frequency of 40 Hz and speed of 1300 rpm. **(8)**

(OR)

13. b. i. Discuss the operation of induction motor with constant slip-speed control. **(8)**

ii. Explain the control of induction motor by voltage source inverter and the methods to control the output voltage. **(8)**

14. a. i. Derive the expression for torque in salient pole synchronous machine. **(8)**

ii. Discuss the power factor control of wound field cylindrical rotor synchronous motor. **(8)**

(OR)

14. b. i. Give the performance equations for operation from a voltage source. **(8)**

ii. Discuss the variable frequency control of multiple synchronous motors. **(8)**

15. a. Derive the transfer function of a separately excited dc motor for armature control.

(OR)

b. i. Design a current controller for a dc motor load system with a damping ratio of 0.707 to obtain a good dynamic performance. **(8)**

ii. Draw and explain the two quadrant dc motor drive with field weakening mode **(8)**