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B.E/ B.Tech. DEGREE END SEMESTER EXAMINATIONS, OCT/NOV 2012

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=100N-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 do you understand by steady state stability?
3. Draw the waveforms of i_a, v_a of dc separately excited motor fed from a three phase fully controlled rectifier for α=60°.
4. A 230V, 960rpm and 200A separately excited dc motor has an armature resistance of 0.02Ω is fed from a chopper. The source has a voltage of 230V. Calculate the duty ratio for braking operation at rated torque and 350 rpm.
5. State two disadvantages of an induction motor fed from a variable voltage supply.
6. What is done to shift the operation of an inverter-fed induction motor from motoring to braking?
7. What is the true synchronous mode of operation of a synchronous motor?
8. Draw the phasor diagram of a cylindrical rotor synchronous machine.
9. How do you select the rating of the converter and its power switches from the motor load specifications?
10. What is the need for field weakening mode of control?

Part –B (5 X 16 = 80 Marks)

11.i. Derive the performance equations of cylindrical wound field rotor synchronous motor drive when fed from the constant voltage and frequency source. Explain the power factor control and draw the V-curves. (10)

ii. Calculate the armature current and power factor at half rated torque and rated field current for a 500kW,3-phase,3.3kV,50Hz, 0.8 (lagging) power factor, 4 pole, star–connected synchronous motor with following parameters: X_s= 15Ω,R_s=0. Rated field current is 10A. (6)

12.a. i) 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)

ii) State and prove the mathematical condition for steady state stability. (6)

(OR)

b. i) A drive has following equations for motor and load torques

$T = 1+2wm, \quad T_l = 3\sqrt{wm}$

Obtain the equilibrium points and determine their steady state stability. (6)

ii) Explain in detail about multi quadrant dynamics in the speed torque plane. (10)

13.a. Draw the power circuit diagram and explain the operation of a 1Φ full converter fed separately excited DC motor. Derive the expression for speed in continuous and discontinuous mode.

(OR)

b. i) Explain the motoring and regenerative braking operation of chopper fed separately excited DC motor drives.

ii) Discuss the four quadrant operation of chopper fed separately excited DC motor drives.

14.a. A 2.8kW, 400V, 50Hz, 4 pole, 1370rpm delta connected squirrel cage induction motor has following parameters referred to the stator.R_s = 2Ω, R'_r = 5Ω, X_s = X'_r = 5Ω X_m = 80Ω. Motor speed is controlled by stator voltage control. When driving a fan load it runs at rated speed at rated voltage. Calculate,

i. Motor terminal voltage, current and torque at 1200rpm.

ii. Motor speed, current and torque for the terminal voltage of 300V.

(OR)

b. i) Explain the VSI fed induction motor drives. What are the methods to vary the output voltage of VSI. (12)

ii) State the drawbacks of an induction motor drive fed from a stepped wave inverter. (4)

15.a. 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)

(OR)

b. Derive the transfer function of armature and field controlled dc motor load system.