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B.E/ B.Tech. DEGREE END SEMESTER EXAMINATIONS, NOV/DEC 2013

ELECTRICAL AND ELECTRONICS ENGINEERING BRANCH

SEVENTH SEMESTER

(1)

EE 9401-SOLID STATE DRIVES

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

Answer ALL Questions

Part –A (10 X 2 = 20 Marks)

1. Write down the equation governing the motor load system.
2. What is the classification of load torques?
3. How the regenerative braking is ~~be~~ achieved in full controlled rectifier fed dc drive?
4. Draw a class of chopper capable of driving the motor in forward motoring and forward braking operation.
5. How dynamic braking is achieved in PWM inverter fed induction motor drive?
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 is true synchronous mode of operation in synchronous motor drive?
9. Why current loop is used in speed control schemes of motor?
10. How do you select the rating of the switches used for motor application?

Part –B(5 X 16 = 80 Marks)

11. i. Derive the performance equations for operation of wound field synchronous machine from a voltage source. (8)

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

12. a. i. State and prove the mathematical condition for steady state stability. (8)

    ii. A drive has following equations for motor and load torques $T = 1+2wm$, $T_l = 3\sqrt{wm}$ Obtain the equilibrium points and determine their steady state stability. (8)

(OR)

12.b.i. Explain in detail about multi quadrant dynamics in the speed torque plane. (8)

ii. A motor is used to drive a hoist. Motor characteristics are given by

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 the hoist is loaded the net load torque T_1=100 N-m, and when it is unloaded net load torque T_1=-80 N-m. Obtain the equilibriums speeds for operations in all quadrants. (8)

13.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: α = 60° and speed = 450rpm (8)

ii. Calculate speed for:α = 45° and torque = 40N-m (8)

(OR)

b.i. What are the control strategies adopted in dc chopper fed dc drives? (6)

ii. Explain the motoring and the regenerative braking opration of chopper controlled separately excited motor with relevant expressions. (10)

14.a.i. 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

1. Speed for the frequency of 30 Hz and 80% of full load torque. (2)
2. Frequency for a speed of 1000 rpm and full load torque. (2)
3. Torque for a frequency of 40 Hz and speed of 1300 rpm. (4)

ii. Discuss the operation of induction motor with constant slip-speed control. (8)

(OR)

b.i. A 440V, 50 Hz, 6 pole, 945 rpm, delta connected squirrel cage induction motor has following parameters referred to the stator : Rs=2Ω, R'r=2Ω, Xs=3Ω,X'r= 4Ω. Motor speed is controlled by stator voltage control. When driving a fan load it runs at rated speed at rated voltage. Calculate motor terminal voltage, current and torque at 800 rpm. (8)

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

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

(OR)

15.b. i. Design a current controller for a dc motor drive maintaining the field flux constant. The motor parameters and ratings are as follows: 220 V, 8.3 3A,1470 rpm,R_a =4 Ω,J=0.0607 K-m_2,L_a=0.072 H, B_t=0.0869N-M/rad/Sec,K_b=1.26 V/rad/sec. The converter is supplied from 230 V,3-phase ac at 60 hz. The converter is linear, and its maximum control input voltage is ±10 V. The maximum current permitted in the motor is 20 A. (8)

ii. Derive the expressions used. (8)