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Question Paper Code : 11188

M.E./M.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Second Semester

Power Electronics and Drives

PX 5202 — SOLID STATE DRIVES

(Regulation 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Input power factor (PF) and Harmonic Factor (HF).

2. Derive the expression for speed from basic drive equations for separately excited dc motor drive.

3. Compare pulse width modulation and frequency modulation.

4. Draw the schematic diagrams for motoring and regenerative braking of dc chopper drive.

5. How slip recovery schemes are advantageous over static rotor resistance control of induction motor drives?

6. How is the speed control of induction motor by variation of slip frequency obtained?

7. How to obtain separately excited dc motor like performance for induction motor drive?

8. What are the merits of field oriented control of induction motor drive over scalar control?

9. Draw and explain the importance "V" curves for synchronous motor.

10. How dynamic braking is superior over plugging for synchronous motor drive?

PART B — (5 × 13 = 65 marks)

11. (a) (i) Explain the operation of three phase full converter fed separately excited dc motor drive with neat sketch. (9)

(ii) Derive the expression for speed for the above drive. (4)

Or

(b) (i) Draw the schematic diagram and waveforms for single phase semi converter fed dc series motor drive for both continuous and discontinuous motor current. (8)

(ii) Derive the torque and speed expressions for continuous motor current for above drive. (5)

12. (a) Explain the In-phase and phase shift operation of multiphase chopper with neat sketch. (13)

Or

(b) Discuss the four quadrant operation of chopper in detail. (13)

13. (a) A 440 V, 50 HZ, 970 rpm, 6-pole, Y-connected, 3-phase wound rotor induction motor has following parameters referred to the stator:

$R_s = 0.1\ \Omega$, $R_r' = 0.08\ \Omega$, $X_s = 0.3\ \Omega$, $X_r' = 0.4\ \Omega$. The stator to rotor turns ration is 2. Motor speed is controlled by Static Scherbius Drive. Drive is designed for a speed range of 25% below the synchronous speed. Maximum value of firing angle is 165°.

Calculate

(i) Transformer turns ratio.

(ii) Torque for a speed of 780 rpm and $\alpha = 140°$.

(iii) Firing angle for half the rated motor torque and speed of 800 rpm.

dc link inductor has a resistance of 0.01 Ω. (13)

Or

(b) A 2.8 kW, 400 V, 50 Hz, 4 pole, 1370 rpm, delta connected squirrel-cage induction motor has following parameters referred to the stator : $R_s = 2\,\Omega$, $R_r' = 5\,\Omega$, $X_s = X_r' = 5\,\Omega$, $X_m = 80\ \Omega$. 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 1200 rpm and (ii) motor speed, current and torque for the terminal voltage of 300 V. (13)

14. (a) Describe the flux vector estimation of direct vector control method for induction motor using Voltage Model. (13)

Or

(b) Explain the following with respect to induction motor drives

(i) Direct torque control using block diagram. (4)

(ii) Derive the torque expression with stator and rotor fluxes. (3)

(iii) The voltage vector selection to control torque and flux simultaneously in DTC. (6)

15. (a) (i) Write short notes on brushless excitation systems. (6)

(ii) Explain the closed loop control scheme of load commutated inverter synchronous motor drive. (7)

Or

(b) (i) Explain the concept of self controlled synchronous motor drive. (7)

(ii) Describe the constant margin angle control of synchronous motor drive. (6)

PART C — (1 × 15 = 15 marks)

16. (a) Describe the variable frequency control of CSI Fed Induction motor drive with neat sketch and analyze its (i) speed torque curves (ii) I_s vs sf curves.

Or

(b) Describe the evaluation of direct torque control of induction motor drives (at least three major optimization methods).

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