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Question Paper Code : 50542

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Sixth Semester

Electrical and Electronics Engineering

EE 8601 — SOLID STATE DRIVES

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the advantages and disadvantages of group drive?
2. A motor of smaller rating can be selected for a short time duty. Why?
3. What are the disadvantages of ward Leonard system drive?
4. Write the expression for average output voltage of full converter fed dc drives.
5. Why induction motor is most suitable for fan type loads?
6. A 3-phase, 460V, 60 Hz, 4 pole induction motor delivers rated output power at a slip of 0.05. Determine (a) Motor speed and (b) Frequency of rated current.
7. List the speed control methods used in synchronous motor.
8. Define torque angle of synchronous motor.
9. What are the functions of feedback loop in an electrical drive?
10. Mention the advantage of using PI type speed controller.

PART B — (5 × 13 = 65 marks)

11. (a) (i) A motor and load have the following characteristics,
 $T = 15 - 0.5 \omega_m$ and $T_L = 0.5 \omega_m^2$. Find the stable operating speed.
Check steady state stability. (8)
- (ii) Explain in detail the multi quadrant dynamics in the speed-torque plane. (5)

Or

- (b) (i) Draw the typical load torque-speed characteristics of fan, high speed hoist, traction and constant power loads. (5)
- (ii) Discuss the different modes of operation of an electrical drive. (8)
12. (a) (i) The speed of a 10kW, 230 V, 1200 rpm separately excited dc motor is controlled by single phase fully controlled bridge converter. The armature resistance is 0.5 ohm and emf constant is 0.182 V/rpm. The single phase ac voltage is 260V. For firing angle of 30 deg and armature current of 30A. Find torque, speed and input power factor. (6)
- (ii) Explain the operation of single-phase semi converter fed separately excited dc motor drive in continuous conduction mode and obtain the expression for motor speed. (7)

Or

- (b) (i) A 220 V, 24 A, 1000 rpm separately excited dc motor is controlled by a chopper. Assume armature resistance of 2 Ω. The chopping frequency is 500 Hz and the input voltage is 230 V. Calculate the duty ratio for a motor torque of 1.2 times of rated torque at 500 rpm. (6)
- (ii) Explain the various control strategies for varying the duty cycle used in chopper drives. (7)
13. (a) (i) Implement the stator voltage control for three phase induction motor using bidirectional ac voltage controller. (8)
- (ii) Explain the speed control of slip ring induction motor using rotor resistance control. (5)

Or

- (b) (i) Show that the no-load speed of the induction motor in the kramer drive can be varied from near standstill to full speed as the firing angle α is varied from 180° to 90°. (9)
- (ii) Compare static Kramer and static Scherbius scheme of speed control. (4)

14. (a) (i) Discuss about the voltage/frequency (V/f) control of synchronous motor drives. (6)
(ii) Explain the margin angle control of synchronous motor drives. (7)

Or

- (b) Describe the operation of self-controlled mode speed control for synchronous motor. (13)
15. (a) Derive the closed loop transfer function of converter fed separately excited DC motor drive. (13)

Or

- (b) (i) Explain the design procedure of speed controller. (7)
(ii) List the factors involved in converter selection and write the equations involved in controller characteristics. (6)

PART C — (1 × 15 = 15 marks)

16. (a) (i) A 2.8 kW, 400 V, 50 Hz, 4 pole, 1370 rpm, delta connected squirrel cage induction motor has the following parameters referred to the stator:
 $R_1 = 2 \Omega$, $R_2 = 5 \Omega$, $X_1 = X_2' = 5 \Omega$ and $X_m = 80 \Omega$. Motor speed is controlled by stator voltage control. When driving a fan load it runs at rated speed and rated voltage. Calculate motor terminal voltage, current and torque at 1200 rpm. (5)
(ii) Starting from the approximate equivalent circuit, derive an expression for the torque developed in an induction motor. Sketch the torque-speed characteristics when stator voltage is varied. (10)

Or

- (b) Develop a typical closed loop control scheme for three phase induction motor drive controlled in field weakening mode.