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Question Paper Code : 40496

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

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 requirements of good adjustable speed drive?

2. Differentiate between active and passive load torques.

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3. Why thyristors are not preferred for chopper fed DC drives?

4. A half controlled single phase bridge converter feeds a separately excited dc motor. Input voltage is 240 V, α = 100 deg, R_a = 6 Ω and I = 1.8 A. Find back emf.

5. Why induction motors are more suitable for pump type and fan type loads?

6. Sketch the speed torque characteristics of 3-phase induction motor. Infer the modes of operation along with torque and power limits.

7. Write down the torque equation of synchronous motor.

8. Compare VSI and CSI fed synchronous motor drive.

9. Draw the basic block diagram of the closed loop control system for an electric drive.

10. Mention the design procedure for a closed loop speed control system.

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PART B — (5 × 13 = 65 marks)

11. (a) (i) Sketch the functional block diagram of electric drive and explain the basic components. (6)

(ii) What is meant by steady state stability? Derive the mathematical condition for steady state stability analysis of equilibrium operating point. (7)

Or

(b) (i) Explain four quadrant operation of a drive with practical example. (8)

(ii) A motor has a cyclic loading as given below :

250 Nm for 15 min

350 Nm for 20 min

100 Nm for 15 min and No load for 10 min

The motor runs at constant speed of 500 rpm. Determine the rating of a suitable motor. (5)

12. (a) (i) The speed of a 10 kW, 230 V, 1200 rpm separately excited DC motor is controlled by single phase fully controlled bridge converter. The armature resistance is 0.5 ohms and emf constant is 0.182 V/rpm. The single-phase AC voltage is 260 V, for firing angle of 30° and armature current is 30 A. Find torque, speed and input power factor. (6)

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(ii) Explain with necessary waveforms and equations of the single phase fully controlled converter fed separately excited DC motor drive in continuous conduction mode. (7)

Or

(b) (i) Discuss the control strategy used for DC chopper drives. (7)

(ii) A separately excited DC motor is fed from a 500 V dc source through a one quadrant chopper. R_a = 0.1 ohm and armature current is 200 A. The voltage and torque constants are 1.4 V/A-rad/sec and 1.4 N-m/A^2 respectively. The field current is 2A. The duty cycle of chopper is 0.5 Find (1) Input power, (2) speed, (3) torque. (6)

13. (a) (i) Implement the stator voltage control for three phase induction motor using AC voltage controller. (6)

(ii) Explain how the slip of the slip ring induction motor can be altered using the static rotor resistance control. Also mention the disadvantages of this scheme. (7)

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(b) (i) How vector control schemes are different from scalar control schemes? Provide the steps involved in the typical vector control with the help of a phasor diagram. (10)

(ii) Why V/f ratio is maintained constant in the speed control of 3-ph induction motor. (3)

14. (a) (i) Explain clearly why a self-controlled synchronous motor is free from hunting oscillations. (10)

(ii) What are the advantage of load commutation in synchronous motor drive? (3)

Or

(b) Discuss the constant margin angle control and power factor control of synchronous motor drive. (13)

15. (a) Explain the armature voltage control of DC motor with constant field and field weakening modes. (13)

Or

(b) (i) Derive the transfer function of speed controller. (6)

(ii) Give the design procedure of current controller. (7)

PART C — (1 × 15 = 15 marks)

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16. (a) (i) A derive has the following parameters : $J = 10\ kg - m^2$, $T = 100 - 0.1\ N - m$, passive load torque $T_L = 0.05$, N-m, where N is the speed in rpm. Initially the drive is operating in steady state. Now it is to be reversed. For this motor characteristics is changed to $T = -100 - 0.1$ N-m. Calculate the time of reversal. (8)

(ii) Write down the approximate expression with respect to converter selection and characteristics. (7)

Or

(b) Explain how the Static Scherbius scheme and Static Kramer scheme helps to achieve sub synchronous speed control of slip ring induction motor with an improvement in overall efficiency. (15)

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