B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2005.

Seventh Semester

Electrical and Electronics Engineering

EE 432 — SOLID STATE DRIVES

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Classify the drive motors based on their speed torque characteristics.

2. List the factors that govern the choice of rating of a motor to be used as a drive element.

3. What is meant by critical speed in phase controlled dc drives?

4. What causes poor input power factor in phase controlled dc drives?

5. What is the need for constant v/f ratio in variable voltage induction motor drives?

6. Sketch the mechanical characteristics of a three phase induction motor with v/f control.

7. Give the expression for Torque of a static rotor resistance controlled three phase induction motor.

8. Where are closed loop control schemes of induction motors preferred?

9. Name the different modes of operation of a synchronous motor drive.

10. What is meant by brushless excitation?

11. (i) Build up the speed torque curves of a DC series motor with shunted armature connection. (8)

    (ii) Distinguish between constant torque and constant H.P. operations of a DC motor. (3)

    (iii) Explain how you would determine the power rating of an electric motor when it is subjected to continuous duty and variable load. (8)

12. (a) (i) Describe a speed control scheme for a separately excited dc motor using a single phase half controlled thyristor bridge converter. (8)

    (ii) A separately excited dc motor is supplied from a 230 Volts 50 Hz source through a single phase half wave controlled rectifier. Its field is fed through a single phase semiconverter with zero degree firing angle delay. The motor armature resistance is 0.7 ohms and motor constant is 0.5 V-sec/radians. For a rated load torque of 15 N-m at 1000 rpm and for continuous ripple free current, determine (1) the firing angle delay of the armature converter (2) input power factor of the armature converter. (8)

Or

    (b) (i) Suggest a SCR based power circuit, fed from a dc supply to control the speed of a separately excited dc motor in both directions and explain its working. (8)

    (ii) A 230 volts 960 rpm 200 Amps separately excited dc motor has an armature resistance of 0.02 ohms. The motor is fed from a dc source of 230 volts through a chopper. Assuming continuous conduction (1) Calculate the duty ratio of chopper for motoring operation at rated torque and 350 rpm. (2) If maximum duty ratio of chopper is limited to 0.95 and maximum permissible motor speed obtainable without field weakening. (4 + 4)

13. (a) (i) Using a diagram and torque speed curve, explain the stator voltage control scheme for the speed control of a three phase induction motor. (6)

    (ii) Bring out the limitations of the above speed control scheme. (3)

    (iii) Explain how voltage and frequency are varied in voltage source inverter fed induction motor drives. (7)

Or

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(b) (i) induction motor speed control with constant supply voltage and reduced supply frequency is rarely used in practice. — Justify. (5)

(ii) Describe the stator frequency control scheme for the speed control of three phase induction motors. (6)

(iii) Why in this method of speed control an induction motor is said to be working in the field weakening mode. (5)

14. (a) (i) Explain using a power circuit how static rotor resistance control serves to vary the speed of a three phase slipring induction motor. (7)

(ii) Bring out its advantages and limitations. (3)

(iii) Derive the expression for torque of the induction motor, when it is working in above scheme. (6)

Or

(b) (i) Draw and explain the slip power recovery scheme applicable for three phase slipring induction motors. (8)

(ii) Show how the above scheme can offer both subsynchronous and super synchronous ranges of speed. (4)

(iii) Compare slip power recovery scheme with rotor resistance control. (4)

15. (a) (i) Describe using a circuit the self controlled mode of operation of a synchronous motor. (10)

(ii) Bring out the need and advantages of closed loop control in a synchronous motor drive. (6)

Or

(b) (i) Suggest a scheme for speed control of synchronous motors using current source inverters and explain its working. (10)

(ii) Discuss how a synchronous motor operating in an overexcited state does not require a commutation circuit and serves to improve the input power factor. (6)