B. Tech.

(SEM. VIII) EXAMINATION, 2006-07

SOLID STATE CONTROL OF ELECTRIC DRIVES

Time : 3 Hours] [Total Marks : 100

Note : Answer all questions.

1. Answer any two parts of the following : 10×2=20
   
   (a) Explain the meaning of solid state controlled electric drives and discuss their advantages, disadvantages and areas of applications. Also describe main parts of modern industrial machines and their functions.

   (b) Describe power supply options required in solid state control drives. How are these supply options achieved through power electronic circuit? Explain the functions of each.

   (c) State and explain performance parameters of phase control d.c. drives. Also explain significance of each parameter.

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2 Answer any two parts of the following:

(a) With the help of circuit connection, load voltage and current, and supply current waveforms, explain the steady state operation of single phase, fully controlled separately excited d.c. drives and continuous mode of conduction. Also derive torque – speed equation.

(b) Explain methods of power factor improvement of d.c. drives using forced commutation.

(c) The speed of a separately excited d.c. motor is controlled by an ideal stepdown chopper circuit with rectangular load voltage waveform. The input to chopper is from an ideal d.c. source of 120 V. The motor back emf constant is 0.05 V/rpm. The motor armature circuit resistance and inductance are 0.5 Ω and 20 mH respectively. The motor drives a constant load torque and takes an average armature current of 20 A and motor is operating under continuous mode. Determine:

(i) The operating range of speed control and

(ii) The range of duty ratio.

3 Answer any four parts of the following:

(a) A three phase, star connected 400 V slip ring induction motor is controlled by the time ratio controlled chopper circuit. When chopper is ON, a resistance of 1.5 Ω is connected in the rotor circuit. When chopper is OFF, and additional resistance of
3.5 Ω is connected in the rotor circuit. Chopper frequency is 220 Hz and OFF time of chopper is 1.5 ms. The resistance values are referred to the stator side. Calculate:

(i) On time of chopper and

(ii) The effective value of the rotor resistance when chopper is in operation.

(b) The speed of a three phase induction motor is controlled by a 3-phase a.c. voltage regulator. Draw schematic arrangement of any two symmetrical a.c. power controlled induction motor drives and compare them.

(c) With neat schematic, explain the operation of slip energy recovery systems. Mention applications of such systems.

(d) Critically examine the range of speed control of an induction motor by frequency control only. And also explain operation of induction motor in field weakening mode.

(e) State and compare scalar and vector control of an induction motor.

(f) Distinguish between brushless d.c. motors and brushless a.c. motor drives. Also give their block diagram representation.

4 Answer any four of the following:

(a) With simplified block diagram, explain important components within the microprocessor. Also explain functions of each component.
(b) With schematic block diagram, explain the working of self controlled current source inverter fed synchronous motor.

(c) Discuss the advantage and disadvantage of microprocessor controlled electric drive systems.

(d) A microprocessor based control scheme is required to be implemented with d.c. separately excited motor to keep the speed of the motor at desired speed. Give the scheme and outline the steps in software design.

(e) Prepare a flow chart for speed regulation, current regulation and change over reversal operation in the proper sequence for a reversing d.c. drive.

(f) Distinguish between analog control scheme and microprocessor based scheme for the speed control of electric motor.

5 Answer any two parts of the following:

(a) Give the basic circuit of d.c. motor speed control using phase locked loop technique in schematic form and explain its working. Also draw its transfer function model.

(b) Give schematic diagram to implement dynamic braking with regenerative braking of d.c. separately excited motor using d.c. chopper and explain its working.

(c) Draw simple arrangement for current control with constant flux operation of 3 phase induction motor. Also explain its operation.