Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.Tech (EE)/SEM-2/EEP-202/2010

2010

ELECTRIC DRIVES — II

Time Allotted : 3 Hours Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* questions. 5 × 14 = 70

1. A 300 kW, 6600 V, 8-pole, 50 Hz, three-phase, Y-connected, non-salient pole (i.e., cylindrical rotor) synchronous motor has the following parameters : Xs = 72Ω/phase at 50 Hz, $R \approx$ 0Ω/phase for operation near base speed, and Efo = 3200 V/phase at base speed.

   i) What is the base speed of the motor in mechanical rad/sec and rev/min ?

   ii) Calculate the load angle of the motor when it delivers rated load at base speed .

   iii) Calculate the motor input current (I) and power factor (PF) of the drive for this condition of operation.

   iv) Calculate the maximum power and torque the motor is capable of developing while running at base speed.

   4 + 4 + 3 + 3

2. A 4-pole, 3-phase, 50 Hz, Y-connected, salient-pole synchronous motor with permanent magnet excitation has the following parameters : Xd = 7·5Ω/phase @ 50 Hz; Xq = 15·7Ω/phase @ 50 Hz; $R \approx 0\Omega$/phase near base speed. The stator induced voltage (emf)/phase is found to be 150 V rms, when the motor runs at 1200 rev/min. 14

3. The motor is driven from a voltage source inverter. The inverter switching control is such that the motor load angle is restrained to 120°. The rms inverter output voltage is proportional to frequency (i.e., constant V/f control). It supplies 200 V rms, to the motor at 50 Hz. Calculate the maximum torque the motor will develop while running at a speed of 1200 rev/min. 14

4. With the help of proper circuit diagram, deduction and torque – speed characteristics explain the operation of rotor resistance control and static rotor resistance control of induction motor. 14

5. Explain the operation of induction motor with

   i) Unbalanced source voltage

   ii) Non-sinusoidal source voltage

   iii) Single phasing cases. $5 + 4\frac{1}{2} + 4\frac{1}{2}$

6. Develop and explain a constant frequency torque and flux controller for direct torque control of induction motor. 14

7. A 2200 V, 50 Hz, 3 ph, 6 pole, Y connected sq. cage induction motor has R_S = 0·075 R'_r = 0·12 ohm. $X_S = X'_r = 0 \cdot 5$ ohm. Calculate

   i) Time taken and energy dissipation during starting.

   ii) Time taken and energy dissipation when it is stopped by plugging.

   iii) Find the value of R to be inserted in the rotor to stop the motor by plugging in the minimum time. Also calculate stopping time and energy dissipated in the motor during braking. 14

8. With the help of proper circuit diagram, deduction and torque – speed characteristics explain the operation synchronous motor as BLDC and BLAC motor. 14

OR

Develop a dynamic model of an induction motor and simulate is using PSPICE or MATLAB. Draw the different waveforms of simulation. 14

9. Develop the controller of cycloconverter fed salient synchronous machine. Use DSP, FPGA and vector control system. 14

OR

How a closed loop 3 ph. Cycloconverter/or inverter /or ac voltage controller based induction motor control system is developed using microprocessor or microcontroller or DSP ? Explain in detail the operation with proper circuit diagram and waveforms. 14

10. Write notes on any *two* of the following : 2 × 7

a) Transfer function of induction motor

b) Reluctance motor drive

c) Fuzzy control of ac motor

d) Braking of PMAC motor.