CS/B.Tech/PWE/SEM-8/PWE-803B/2013

2013

ELECTRIC DRIVES

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.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : 10x1 = 10

i) The load torques which usually retain their sign when the direction of the drive motion (rotation) is changed are

a) passive load torques

b) active load torques

c) both active and passive load torques

d) none of these.

ii) The armature control scheme for the speed control of d.c. motor is used for

a) controlling the speed above the base speed

b) controlling the speed below the base speed

c) both (a) and (b)

d) none of these.

iii) In chopper fed drive the speed is controlled by changing

a) the duty cycle

b) the firing angle

c) either (a) or (b) at a time

d) all of these.

iv) The speed-torque characteristics of a d.c. series motor is

a) a straight line passing through origin

b) hyperbolic in nature

c) parabolic in nature

d) a straight line having negative slope.

v) Static scherbius drive method allows

a) sub-synchronous speed control

b) super-synchronous speed control

c) both sub-synchronous and sub-synchronous speed control

d) neither sub-synchronous nor sub-synchronous speed control.

vi) Viscous torque is

a) directly proportional to the speed of the motor

b) directly proportional to the square of the speed of the motor

c) inversely proportional to the speed of the motor

d) not related with the speed of the motor.

vii) A motor driving a passive load is said to be steady state stable if

a) $dT_L/dw = dT_M/dw$

b) $dT_L/dw < dT_M/dw$

c) $dT_L/dw > dT_M/dw$

d) None of these.

viii) Most suitable excitation system for large synchronous motor drive is

a) d.c. excitation

b) static excitation

c) brushless excitation

d) both (b) and (c).

ix) In case of stepper motor, rotor carries

a) poly-phase distributed winding

b) single-phase distributed winding

c) concentrated type winding

d) no winding.

x) Regenerative braking is not possible for

a) separately excited d.c. motor

b) d.c. shunt motor

c) d.c. series motor

d) cumulatively compound d.c. motor.

xi) Which type of d.c. motor is most suitable for traction drive ?

a) Cumulatively compound d.c. motor

b) Differentially compound d.c. motor

c) d.c. shunt motor

d) d.c. seris motor.

xii) Why does the reluctance motor have low efficiency ?

a) Because of constant reluctance

b) Because of varying reluctance

c) Because of constant current

d) The question is wrong. It has higher efficiency.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3x5 = 15

2. Classify electric drives with suitable examples. State the differences between active and passive torques.

3. Obtain the equilibrium points and determine the steady state stability when motor and load torque are

$T_m = -1 - 2w$

$T_L = -3\sqrt{w}$.

where w = speed in rad/sec.

4. Establish the speed-torque characteristics of a d.c. series motor from the basic voltage and torque equations. Also draw the above mentioned characteristics for this motor.

5. Describe the plugging operation of Induction motor with necessary circuit diagram and waveforms.

6. Write down a short note on cyclo-converter fed synchronous motor.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3x15 = 45

7. a) List down the basic elements of an electric drive and draw the block diagram of an electric drive system using these elements. 3

b) Mathematically establish the condition for steady-state stability of an electric drive. 6

c) A drive has following parameters :

$J = 10$ kg-m^2; $T = 15 + 0.05\,N$ in N-m; $T_L = 5 + 0.06\,N$ in N-m, where N = speed in rpm.

Initially the drive is working in steady state. Now the drive is braked by electrical braking.

Torque of the motor in braking is given by

$T = -10 - 0.04\,N$ in N-m. Calculate time taken by the drive to stop. 6

8. a) Discuss the buck-boost scheme for the speed control of d.c. motor. 4

b) Describe the dynamic braking operation of a separately excited d.c. motor by chopper control and show that the effective value of braking resistance can be changed by changing the duty cycle of the chopper. 7

c) A 4 kW, 230 V, 1000 rpm separately excited d.c. motor is fed from 260 V a.c. source through a single-phase

full converter. At no-load and with zero firing angle delay, the motor draws 2A and runs at 1100 rpm. The armature circuit resistance is 0.5 ohm. Voltage drop in conducting thyristors is 2V. For a firing angle delay of 30 degree and rated armature current of 20 A compute (i) the motor torque (ii) motor speed. 4

9. a) Discuss the regenerative braking of Induction motor with suitable circuit diagrams. 4

b) Describe the slip power recovery schemes of induction motor with neat diagrams. 7

c) A static Kramer drive is used to control the speed of a 4-pole induction motor fed from a 3-phase, 400 volt, 50 Hz supply. The inverter is directly connected to the supply. If the motor is required to operate at 1200 rpm, determine the firing angle of the inverter. Voltage across the open circuit slip-rings at standstill is 500 volt. Allow a voltage drop of 1.8 volt across the diode bridge and 3.2 volt across the inverter. Neglect voltage drop across the inductor. 4

10. a) What are the factors to be considered in selecting a motor power rating ? 5

b) What are the different classes of motor duty cycle ? Explain with one example of each class. 5

c) Discuss about the brushless excitation system of synchronous motor. 5

11. Write short notes on any *two* of the followings : 7.5+7.5

a) Ward-Leonard scheme for the speed control of d.c. motor

b) VSI controlled induction motor

c) Electric Traction

d) Stepper motor.