Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (EE-OLD)/SEM-7/EE-701/2009-10

2009
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 : $10 \times 1 = 10$

   i) To get speed higher than the base speed of *d.c.* shunt motor

      a) armature voltage control is used

      b) field control is used

      c) armature resistance control is used

      d) none of these.

   ii) A variable frequency variable voltage induction motor

      a) can be accelerated at constant torque or constant current

      b) suffers from poor starting characteristics as in the case of mains fed motor

      c) has only steeped variation of speed

      d) suffers from stability consideration.

iii) Stator voltage control for speed control of I.M. is suitable for

a) fan and pump drives

b) drive of a crane

c) running it as generator

d) constant load drive.

iv) Motors preferred for rolling mill drive are

a) *d.c.* motors

b) *a.c.* slip-ring motors with speed control

c) any of these

d) none of these.

v) In a fan motor the load torque is proportional to

a) speed b) $(\text{speed})^2$

c) $\frac{1}{\text{speed}}$ d) $\frac{1}{(\text{speed})^2}$.

vi) The ripple frequency is twice the supply frequency in the case of

a) single phase half-wave converter

b) single phase dual converter

c) three phase full converter

d) three phase semi-converter.

vii) The common method of speed control used in 25 kV, 50 Hz, 1-phase traction system is

a) tap changing control

b) reducing current method

c) series parallel method

d) none of these.

viii) The free wheeling diode is needed with inductive load in

a) single phase half converter drive only

b) single phase semi-converter drive only

c) single phase full converter drive and single phase dual converter drive

d) both single phase half converter drive and single phase full converter drive.

ix) A three phase induction motor having a combination of diode rectifier & line commutated inverter in rotor circuit, can give

a) speed below synchronous speed only

b) speed above synchronous speed only

c) both sub- & super-synchronous speed

d) no change in speed.

x) Which operation is not possible for semi-converter fed D.C. drive system ?

a) IInd quadrant (V-I) b) III quadrant

c) IVth quadrant d) all of these.

xi) The value of co-efficient of adhesion will be high when rails are

a) greased b) wet

c) sprayed with oil d) none of these.

GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Discuss the factors on which the size and rating of a motor to be used as a drive element depend.

3. Describe the operation of dual converter for four quadrant operation.

4. Make a comparative study between conventional *d.c.* motor drive and a brushless *d.c.* motor drive.

5. Obtain the expression of the moment of inertia of the flywheel incorporated under shocking load conditions.

6. Explain the operation of a diesel traction drive employing a torque converter consisting of an alternator, diode bridge and *d.c.* series motors.

GROUP – C
(Long Answer Type Questions)
Answer any *three* of the following. 3 × 15 = 45

7. a) What do you mean by 'Electric Drive' ?

b) How are electrical drives classified ? Explain each class with examples.

c) A motor is used to drive a hoist. Motor characteristics are given by :

Quadrant I, II & IV : T = 200 – 0·2 N, Nm

Quadrant II, III & IV : T = – 200 – 0·2 N, Nm

where *N* is the speed in rpm.

When hoist is loaded, the net load torque T_l = 100 Nm and when it is unloaded, the net load torque T_l = – 80 Nm. Obtain the equilibrium speeds for operation in all the four quadrants. 3 + 6 + 6

8. a) Explain the method of speed control of induction motors using a variable frequency supply.

b) A star connected squirrel-cage induction motor has the following ratings and parameters :

400 V, 50 Hz, 4-pole, 1410 rpm, $R_r = 2\,\Omega$, $R_r^{\prime} = 3\,\Omega$, $X_S = X_r^{\prime} = 3{\cdot}5\,\Omega$. It is controlled by a current source inverter at a constant flux. Calculate

i) motor toque, speed when operating at 30 Hz and rated slip speed

ii) inverter frequency for rated motor torque at a speed of 1250 rpm. 6 + 9

9. a) Why does a synchronous motor not have starting torque ? What is the role of damper winding in synchronous motor ?

b) What is micro-stepping ? Explain torque *vs* stepping rate of a stepper motor.

c) What are the main features of stepper motor which are responsible for its widespread use.

d) Explain the advantages of using electric braking instead of mechanical braking. 4 + 5 + 4 + 2

10. a) Explain the principle of dual converter for circulating mode.

b) An electric train weighing 600 tonnes climbs up-gradient with G = 15. Speed-time curve has the following details :

i) Uniform acceleration of 3 kmphps for 50 sec

ii) Constant speed operation for 10 min.

iii) Uniform braking at 2·5 kmphps to rest.

Assume efficiency of transmission system and motor during regeneration to be the same as during motoring. Calculate the energy consumption for starting, uniform speed interval and braking. 5 + 10

11. Write short notes on any *three* of the following : 3 × 5

a) Speed control to stepper motor

b) Microprocessor based controller for *d.c.* drives

c) Chopper fed drives

d) EMU

e) Drives used in cement making.