Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (EE-NEW)/SEM-7/EE-701/2010-11

2010-11

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) For applications in cranes

      a) *d.c.* shunt motors are suitable

      b) *d.c.* series motors are suitable

      c) induction motors are suitable

      d) synchronous motors are suitable.

   ii) The heating time constant of an electrical machine gives an induction of its

      a) cooling b) rating

      c) overload capacity d) short time rating.

iii) For plugging in induction motor

a) rotor & stator magnetic fields move in opposite directions

b) rotor & stator magnetic fields move in same direction

c) slip becomes greater than unity

d) both (a) & (c).

iv) Speed control by varying armature voltage offers

a) constant power drive

b) constant torque drive

c) variable power drive

d) variable torque drive.

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

a) $speed$ b) $\frac{1}{speed}$

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

vi) The speed-torque curve of a separately excited motor is a

a) hyperbola b) straight line

c) circle d) none of these.

vii) A three phase induction motor operates at a constant rotor frequency when the stator frequency is varied from zero to rated value. The torque developed by the motor is

a) constant from zero to rated speed

b) proportional to speed

c) proportional to square of speed

d) inversely proportional of speed.

viii) If slip for the plugging is denoted by s_n, then

a) $s_n = s - 1$ b) $s_n = 2 - s$

c) $s_n = 2s - 1$ d) $s_n = 2/s$.

ix) Most efficient braking is

a) dynamic braking

b) regenerating braking

c) both (a) & (b)

d) none of these.

x) In a thyristor *d.c.* chopper, which type of commutation results in best performance ?

a) voltage commutation

b) current commutation

c) load commutation

d) none of these.

xi) 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 semiconverter.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Mention & explain the factors on which size & rating of a motor to be used as a drive element depend.

3. Show that during starting, if the slip of the induction motor running under no-load friction torque changes from 1 to 0, the energy lost in the rotor circuit is given as

$W_{st} = 1/2 JW_s^2$ joules. The symbols have usual meanings.

4. A weight of 500 kg is being lifted up to at a uniform speed of 1·5 m/s by a winch drive by a motor running at a speed of 1000 rpm. The moments of inertia of the motor and winch are $0{\cdot}5\ kg\text{-}m^2$ and $0{\cdot}3\ kg\text{-}m^2$ respectively. Calculate the motor torque and the equivalent moment of inertia referred to the motor shaft. In the absence of weight motor develops a torque of 100 N-m when running at 1000 rpm.

5. The temperature rise of motor when operating for 25 min on full-load is 25° C and becomes 40° C when the motor operates for another 25 min on the same load. Determine heating time constant and the steady state temperature rise.

6. Why VVVF method of speed control of a three phase induction motor is preferable to the frequency control method ?

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) With the help of relevant torque-speed characteristics, discuss different methods of braking of D.C. shunt motor.

   b) A 500 V D.C. shunt motor taking an armature current of 240 A, while running at 800 rpm, is braked by disconnecting the armature from supply and closing it on resistance of 2·02 Ω, the field excitation remaining constant. The armature has a resistance of 0·5 Ω. Calculate the initial braking current. 12 + 3

8. a) Draw the speed-torque characteristics for dynamic braking operation of *d.c.* series motor. Why does torque become zero at finite speed ?

b) A 230 V separately excited *d.c.* motor takes 50 A at a speed of 800 rpm. It has armature resistance of 0·4 Ω. This motor is controlled by a chopper with an input voltage of 230 V and frequency of 500 Hz. Assuming continuous conduction throughout, calculate the speed-torque characteristic for

i) motoring operation at duty ratios of 0·3 and 0·6

ii) regenerative braking operation at duty ratios 0·7 and 0·4 6 + 9

9. a) Explain how cycloconverter can be used to control the speed of synchronous motor drives.

b) What do you mean by soft start ?

c) Explain the principle of operation of VVVF control of induction motor. 6 + 2 + 7

10. A three phase, 400 V, 50 Hz, 6 pole, 960 rpm, star-connected wound rotor induction motor has following constants referred to the stator :

$r_1 = 0 \cdot 5$ ohm, $r_2' = 0 \cdot 7$ ohm, $x_1 = x_2' = 1 \cdot 5$ ohm

The motor drives a fan load at 960 rpm. The stator to rotor turns ratio is 2. Calculate the resistance required to be connected in each phase of the rotor circuit to reduce the speed to 600 rpm.

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

a) Drive for textile mills

b) V/f control of induction motor

c) Stepper motor

d) Multiquadrant operation of electric drive.