Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech(EE-New)/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) A single motor which actuates several mechanisms or machines is called

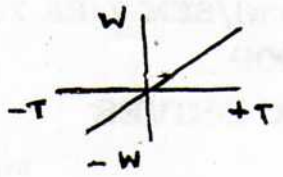
a) group drive

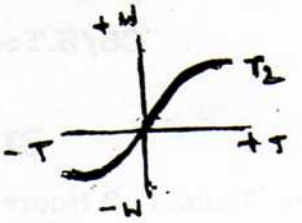
b) individual drive

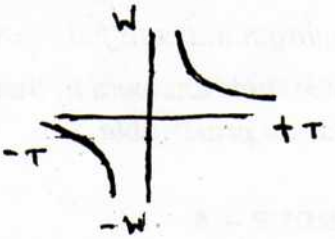
c) multi-motor drive

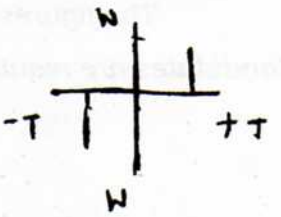
d) active drive.

ii) The speed-torque curve of a fan type load is given by

a) 

b) 

c) 

d) 

iii) $\pm T_M = \pm T_L + J\frac{dW}{dt}$, if $T_M < T_L$, for active load, it means

a) the drive will be accelerating

b) the drive will be decelerating

c) the drive will run at the same speed

d) the drive may accelerate or decelerate.

iv) The regenerative braking is not possible in

a) DC serier motor

b) induction motor

c) DC shunt motor

d) DC separately excited motor.

v) The loss in energy during starting with m equal steps of voltage can be expressed as

a) $\frac{1}{2}Jw_0^2$ b) $\frac{1}{2m}Jw_0^2$

c) $\frac{m}{2}Jw_0^2$ d) $\frac{1}{2m^2}Jw_0^2$.

vi) For plugging in induction motor

a) rotor & stator magnetic field move in opposite directions

b) rotor & stator magnetic field move in same direction

c) slip becomes greater than unity

d) both (a) & (c).

vii) The power rating of electric motor for continuous duty & constant load having torque T in kgm & speed N in rpm is given by

a) $\frac{TN}{975\eta}$ b) $\frac{TN}{102\eta}$

c) $\frac{TN}{9{\cdot}75\eta}$ d) $\frac{TN}{10{\cdot}2\eta}$.

viii) For increasing the speed of an induction motor, the frequency of the supply is increased by 20%. In order to operate the motor at the same flux condition, the supply voltage must

a) remain constant b) be reduced by 10%

c) be reduced by 20% d) be increased by 20%.

ix) Field control of a DC shunt motor gives

a) constant torque drive b) constant kW drive

c) constant speed drive d) variable load drive.

x) For application in cranes

a) differentially compounded motors are suitable

b) cumulatively compounded motors are suitable

c) *dc* shunt motors are suitable

d) *dc* series motors are suitable.

xi) The motor having slip energy recovery scheme can be braked by means of

a) regenerative braking

b) plugging

c) *dc* dynamic braking

d) all the methods of (a), (b) & (c)

xii) A current source inverter fed induction motor is inherently unstable when it operates in

a) open loop

b) closed loop

c) a variable frequency supply keeping air gap flux constant

d) a variable frequency supply keeping stator flux constant.

GROUP – B

(Short Answer Type Questions)

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

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

3. A horizontal conveyer belt moving at a uniform velocity of 1 m/sec transports load at the rate of 50,000 kg/hour. The belt is 180 m long & is drive by a 960 rpm motor :

   a) Determine the equivalent rotational inertia at the motor shaft.

   b) Calculate the required braking torque of the motor shaft to stop the belt at a uniform rate in 10 sec.

4. Deduce an expression for the energy lost during starting of DC shunt motor with constant load torque T_L.

5. The temperature rise of a motor after operating for 30 minutes on full load is 20°C, after another 30 minutes on the same load, the temperature rise becomes 30°C. Assuming that the temperature increases according to an exponential law, determine the final temperature rise & the time constant.

6. Deduce a condition for steady state stability for drive system. Can the condition deduced be applied to synchronous motor drive ?

GROUP – C
(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Explain equivalent current, torque & power methods to determine the motor rating for intermittent loads.

   b) A motor driving a mining equipment has to supply a load rising uniformly from zero to a maximum of 1500 kW in 20 seconds during acceleration period, 1000 kW for 50 seconds during the full-load period & during acceleration period of 10 seconds when regenerative braking takes place, the kW returned to the mains falls from an initial value of 500 kW to zero uniformly. The interval for decking before the next load cycle starts is 20 seconds. Estimate a suitable kW rating of the motor, based on rms power. 8 + 7

8. a) Explain with relevant circuit diagram and torque-speed characteristics, the principle of Rheostatic braking applied to induction motor.

   b) A 3-phase star connected, 400V, 50 Hz, 4-pole induction motor has the following equivalent circuit parameters referred to stator in ohms per phase : $R_1 = 0{\cdot}8$, $R_2 = 0{\cdot}3$, $X_1 = X_2 = 2$; $X_m = 48$. An external resistance of 2Ω per phase referred to stator has been inserted in the rotor circuit in order to brake the motor at 1440 rpm by means of *dc* rheostatic braking. Determine the initial braking torque. 9 + 6

9. a) Explain the principle of slip power recovery scheme of controlling the speed of induction motor, using static Kramer drive.

b) A 220V, 150A, 875 rpm *dc* separately excited motor has an armature resistance of 0·06Ω . It is fed from a single phase fully controlled converter with an *ac* source voltage of 220V, 50 Hz. Assuming continuous conduction, calculate

i) firing angle for motor torque, 750 rpm.

ii) firing angle for rated motor torque, (– 500) rpm.

iii) motor speed for $\alpha = 160^\circ$ & rated torque. 7 + 8

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

b) "A motor of smaller rating can be selected for an intermittent periodic duty." Justify the statement by calculating the ratio of rated power P_r to P_x corresponding to duty cycle. 7 + 8

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

a) Drive for paper mills

b) Brushless DC motors

c) Solar & battery powered drive

d) Chopper control of DC drive.