

2012

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 × 1 = 10

i) The field control scheme of DC separately excited motor is applied when

- a) controlling the speed below base speed
- b) controlling the speed above base speed
- c) stopping the motor from running
- d) none of these.

ii) In a controlled rectifier the voltage is controlled by changing

- a) the duty cycle b) firing angle
- c) both (a) and (b) d) none of these.

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

- a) $\frac{dT_L}{dw} > \frac{dT_M}{dw}$ b) $\frac{dT_L}{dw} = \frac{dT_M}{dw}$
- c) $\frac{dT_L}{dw} < \frac{dT_M}{dw}$ d) none of these.

iv) In static Kramer drive method

- a) slip power can flow in both directions
- b) slip power can flow only in one direction
- c) slip power cannot flow
- d) none of these.
- v) Viscous friction 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 to the speed of the motor.
- vi) In an induction motor drive the regenerative braking takes place when
- a) the rotor rotates in the same direction as that of stator magnetic field
 - b) the rotor speed equals synchronous speed
 - c) the rotor speed is greater than synchronous speed
 - d) none of these.
- vii) The speed-torque characteristics of a DC shunt motor is
- a) hyperbolic in nature
 - b) parabolic in nature
 - c) a straight line with negative slope
 - d) none of these.
- viii) During plugging, the slip of an induction motor is given by
- a) s b) $2 - s$
 - c) $1 - s$ d) $1 + s$.
- ix) In crane drive the motor duty cycle is of
- a) continuous type b) short time type
 - c) intermittent type d) none of these.
- x) Core saturation of an induction motor would cause
- a) excessive copper losses
 - b) excessive iron losses
 - c) poor power factor
 - d) none of these.
- xi) The excitation of almost all large turbo-alternators is done by
- a) *dc* exciters with brushes

- b) static exciters
 - c) brushless *dc* exciters
 - d) none of these.
- xii) Regenerative braking is not possible for
- a) separately excited *dc* motor
 - b) *dc* shunt motor
 - c) *dc* series motor
 - d) *dc* compound motors.

GROUP – B

(Short Answer Type Questions)

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

2. Classify electric drive with suitable examples. State the differences between active and passive torques. 3 + 2
3. Derive the speed-torque characteristic equation for a *dc* separately excited motor. Also draw the characteristics for the above-mentioned motor. 4 + 1
4. Briefly discuss the constant v/f control technique for speed control of three-phase induction machines.
5. What is plugging operation in a *dc* separately excited motor ? Show the characteristics diagram for the same. 3 + 2
6. Briefly describe the method of soft starting method indicating functions and applications.

GROUP – C

(Long Answer Type Questions)

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

7. a) List down the basic elements of an electric drive and draw the block diagram of the same. 3
- b) Mathematically establish the condition of the steady state stability of an electric drive. 6
- c) A drive has following parameters :
 $J = 10 \text{ kg-m}^2, T = (15 + 0.05 N) \text{ N-m}, T_L = (5 + 0.06 N) \text{ N-m},$
 where N is the speed in r.p.m. The motor is braked from

its steady state condition. The torque during braking is given by $T = -10 - 0.04 N$. Calculate the time taken by the drive to stop. 6

8. a) Discuss the speed control method of *dc* separately excited motor with controlled rectifiers. 6

b) Discuss the dynamic braking process of a separately excited *dc* motor by chopper control. 4

c) A 4 kW, 230 V, 1000 rpm separately excited *dc* motor is fed from 260 V *ac* source through a single phase fully controlled converter. At no load with rated voltage the motor draws 2A at 1050 rpm. The armature circuit resistance is 0.5 Ω . Calculate the motor speed for a firing delay angle of 30° and an armature current of 20A. Neglect thyristor drop. 5

9. a) Discuss the speed control technique of wound rotor induction machine by static resistance control method. 6

b) Briefly discuss the dynamic braking process of induction motor with necessary circuit and characteristic diagrams. 5

c) What are the factors to be considered in selecting a motor power rating ? 4

10. a) Briefly discuss about the operation of cycloconverter fed synchronous motor drive. 5

b) Discuss with diagrams the different starting techniques for 3-phase squirrel cage type induction machines. 6

c) Discuss about different duty classes of motors. Explain with one example for each class. 4

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

a) Speed control of *dc* motor through buck-boost converter

b) Electric traction

c) Static excitation system of synchronous motor drive

d) VSI controlled induction motor

e) Ward-Leonard scheme of speed control of *dc* motor

f) Electric traction.

