8E4110

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B. Tech. (Sem. VIII) (Main/Back) Examination, April/May-2012
Electrical Engg.
8EE2 Electric Drives and Their Control
Common for 8EE2, 8EX2

Time : **3** Hours] [Total Marks : **80**
[Min. Passing Marks : **24**

*Attempt any **five questions**, selecting **one question** from each **unit**. **All** questions carry **equal** marks. (Schematic diagrams must be shown wherever necessary.) Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.*

Use of following supporting material is permitted during examination.
(Mentioned in form No. 205)

1. Nil 2. Nil

State suitable assumptions.
Symbols used in the question paper are as follows :

J Moment of intertia, kgm^2
T Motor torque, Nm
T_L Load torque, Nm
ω_m Angular speed, rad/sec
N Speed, rpm
R_1' Stator resistance of induction motor referred to rotor side
R_2 Rotor resistance of induction motor
X_1' Stator reactance of induction motor referred to rotor side.
X_2 Rotor reactance of induction motor
α Firing angle in degrees,

UNIT - I

1 (a) Calculate the starting time of a drive with following parameters.

$J=25\ kgm^2$, $T = 18+0.5\ \omega_m$ and $T_L = 15 + 0.6\ \omega_m$ 6

(b) Explain that the steady-state stability of a drive depends on relative characteristics of the motor and load and not just on motor (or load) characteristics. Find the criterion of steady-state stability of a motor load system.

4+6

2 (a) A weight of 350 kg is being lifted up at a uniform speed of 2 cm/s by a winch driven by a motor running at a speed of 30 rad/s. The moment of inertia of the motor and winch are 0.5 and 0.4 kg-m^2 respectively. Calculate the motor torque and equivalent moment of inertia referred to the motor shaft. In the absence of weight, motor develops a torque of 200 Nm when running at 30 rad/s.

4+4

(b) What are the reasons for using load equalization in an electric drive ?

8

UNIT - II

3 (a) A 220 V, 800 rpm, 150 A separately excited motor has armature and field resistances of 0.01 Ω and 10 Ω respectively. Load torque is given by the expression $T_L = 300\text{-}0.1\,N$ N-m. Speeds below rated value are obtained by armature voltage control with full field and the speeds above rated are obtained by field control at rated armature voltage.

Armature is fed from a three phase fully controlled rectifier with ac source voltage (line) of 220 V, 50 Hz and the field is fed from a fully controlled single phase rectifier with a single phase source voltage of 220 V, 50 Hz. DC drive operated under continuous conduction.

Calculate firing angles for the speed of (i) 700 rpm and (ii) 900 rpm of the DC drive.

6+6

(b) A separately excited dc motor is running on no-load with weak field. Now field current is increased. State and explain various operations (motoring, braking) the motor will have before it settles at a new steady-state speed.

4

4 (a) Discuss motoring and braking of chopper fed DC motor.

8

(b) A 220 V, 1225 rpm, 16A, separately excited motor has an armature resistance of $1\,\Omega$. Motor is operated under dynamic braking with chopper control. Braking resistance has a value of $30\,\Omega$.

(i) Calculate duty ratio of chopper for motor speed of 1150 rpm and braking torque equal to 1.5 times rated motor torque.

(ii) What will be the motor speed for duty ratio of 0.75 and motor torque equal to its rated torque.

4+4

UNIT - III

5 (a) Explain different braking methods in induction motor drives.

10

(b) Compare stator voltage control and variable frequency control methods used for induction motor drives.

6

6 A 3-phase, 6-pole, 50 Hz star connected 381.04V, 950 rpm, squirrel cage induction machine has following parameters (referred to rotor side at standstill).

$R_1' = 0.35\,\Omega$, $R_2 = 0.45\,\Omega$, $X_1' = X_2 = 2.5\ \Omega$

The motor is fed from a voltage source inverter with a constant V/f ratio from 0 to 50 Hz and constant phase voltage of 220 V above 50 Hz.

(i) Determine the breakdown torque for a frequency of 100Hz as a ratio of its value at 50 Hz.

(ii) Also obtain the torque at the rated motor current and 75 Hz as the ratio of rated full load torque of the motor.

(iii) Calculate the motor torque at 30 Hz and a slip speed of 60 rpm.

The rotor to stator turns ratio is 1:4.

8+4+4

UNIT - IV

7 (a) Why is the power factor of the slip power recovery scheme of speed control of induction motor is low ?

4

(b) Why the CSI fed induction motor drive is operated at a constant rated flux ? Explain it.

4

(c) Explain closed loop static rotor resistance control method of induction motor drives. 8

8 A 3-phase, 6-pole, 50 Hz, star connected, 381.04 V, 1000 rpm, squirrel cage induction machine has following parameters (referred to rotor side at standstill)

$R_1' = 0.24\,\Omega$, $R_2 = 0.46\,\Omega$, $X_1' = X_2 = 2.8\,\Omega$

The rotor to stator turns ratio is 1:2.

The motor speed is controlled by static scherbius drive. The drive is designed for a speed range of 30% below the synchronous speed. The maximum value of firing angle is 165°. Calculate

(i) Turns ratio of the transformer

(ii) Torque for a speed of 850 rpm and $\alpha = 120°$.

(iii) Firing angle for half the rated motor torque and a speed of 850 rpm.

Dc link inductor has resistance of $0.05\,\Omega$.

6+6+4

UNIT - V

9 Explain in detail the dynamic and regenerative braking of synchronous motor with voltage source inverter. 8+8

10 Write short notes on :

(a) Control of synchronous motor using current source inverter. 8

(b) Control of synchronous motor using voltage source inverter. 8
