1hp ≈ 746W

ELL332 Electric Drives

Major Test

Date: 3/5/2017 13:00 to 15:00 Hrs

Venue: LH 308

Max Marks: 40

1. Short Questions: (5 x 2= 10 MARKS)

A. A rolling mill of 120 kW capacity is operated by a DC motor. The power available is from a regular power supply grid. Which of the following drives would be best suited and why? - 3 phase converter fed DC drive, 1-phase converter fed DC drive, 2-quadrant Chopper fed DC drive.

B. A Permanent Magnet DC motor is commonly used for applications below its base speed only - State True or False and justify.

C. While starting a wound field synchronous motor with the help of its damper windings, its field will be normally open circuited while the armature is connected to the 3-phase 50 Hz supply. Is this statement TRUE? Justify.

D. The best way of achieving speed control of a 3-phase cage induction motor is to control the applied voltage by a 3-phase AC voltage controller. Is this statement TRUE? Justify.

E. Draw the family of Speed-Torque characteristics for: (i) a 3-phase cage induction motor undergoing capacitor braking with two different values of capacitors (C1 and C2 where C1> C2). (ii) a 3-phase wound rotor induction motor operating with a slip energy recovery scheme with the thyristor converter on its rotor side operating at different firing angles.

2. A 2.2 kW, 3-phase, 400V, 50Hz, 4-pole, 1450 rpm Δ-connected induction motor draws a current of 27 A while started direct-on-line. At rated load conditions its efficiency and power factor are 88% and 0.8 respectively. Calculate its starting current and starting torque while employing star-Δ starting. If the starting line current is to be reduced to 6.75A using a 3-phase auto-transformer (variac), calculate the turns ratio of this variac (supply side to motor side) and the corresponding starting torque. (6 MARKS)

3. A 220 V 20 kW DC shunt motor running at its rated speed of 1200 rpm is to be braked by reverse current braking. Ra=0.1Ω Rated efficiency of the machine is 90%. Calculate (a) R_{ext} to be connected in series with the armature to limit the initial braking current to twice the rated value. (b) the initial braking torque (c) torque when the speed falls to 400 rpm. (5 MARKS)

4. A 3-phase 15 kW, 415V, 50Hz, 6-pole, 970 rpm Y connected induction motor gave the following test results under blocked rotor test: 200V, 50A, 7.188 kW. The motor drives a load having a constant torque of 175 Nm. (i) Estimate the possible reduction in supply voltage before the motor stalls assuming that the copper losses are equally divided between the stator and rotor. Neglect the magnetizing current. (ii) Derive the equivalent circuit for this motor while being supplied with a voltage at nth harmonic frequency. (7.5 MARKS)

5. Draw the circuit configuration for a static Scherbius drive (with a transformer on the inverter side) and the corresponding phasor diagram showing supply voltage , no-load current, rotor and stator currents of the induction motor, inverter current and the total current. (4 MARKS)

6. A 3 hp, 120 V, 1000 rpm separately excited DC motor is controlled by a buck chopper whose frequency and input voltage are 500 Hz and 180 V respectively. Ra=0.8 Ω La=3 mH Back emf constant=1.0 V.sec/rad. The motor is to be run at rated torque at 300 rpm with a maximum torque pulsation of 5%. Is this chopper suitable for this application? Justify your answer by proper calculations (using R-L circuit transient equations). If not, suggest a suitable frequency of operation for the chopper (by appropriate calculations). (7.5 MARKS)

INDUCTION MOTOR EXPRESSIONS:

$$T_e = \frac{3V_1^2 R_2'/s\omega_s}{(R_1 + R_2'/s)^2 + (x_1 + x_2')^2}$$

$$T_{BD} = \frac{3V_1^2}{2\omega_s\{R_1 \pm \sqrt{R_1^2 + (x_1 + x_2')^2}\}}$$

(+) for motoring } operation
(−) for generating }

$$s_{maxT} = \pm \frac{R_2'}{\sqrt{R_1^2 + (x_1 + x_2')^2}}$$

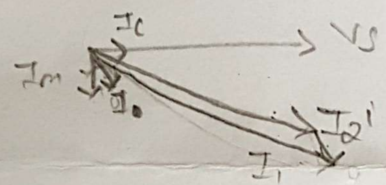
EEL332 Electrical Drives System
Surprise Quiz -6

Entry No: 2014EE10468 Name:- Parvez Chanawala
Date: 24th Apr 2017 Max Marks: 5

1. An induction machine working as a motor always draws lagging current whereas an induction generator will always have its current leading its terminal voltage. Is this statement TRUE? Justify your answer. Also, draw the phasor diagram of an induction machine indicating stator, rotor and magnetizing currents for (i) generator mode (ii) motoring mode of operation. **(3 Marks)**

→ No. Statement is False.
→ While generation, a voltage will be induced across the terminals of the rotor and when we close the terminals, current begins to flow. But since the elements in the circuit are inductive, current will still be lagging.

2



Motor

2. An induction machine working with a slip 's' has the rotor induced emf frequency to be 'sf' where 'f' is the frequency of the applied voltage in the stator. When the machine is working as a generator, the slip value is negative. During this condition, is the rotor frequency negative? If not, what happens to the rotor induced emf actually during this condition? (**2 Marks**)

No.
Induced emf will be such that if we close the rotor terminals, current will generate a rotating magnetic field which will rotate in the same direction as that of ω_r (ω of rotor).

1

So what?