ECE 3600 homework # 17 Due: Tue, 11/17/09 b

Answer the following questions in your textbook, p.348.

7-11. Why is it necessary to reduce the voltage applied to an induction motor as electrical frequency is reduced?

7-12. Why is terminal voltage speed control limited in operating range?

7-13. What are starting code letters? What do they say about the starting current of an induction motor?

7-14. What information is learned in a locked-rotor test?

7-15. What information is learned in a no-load test?

Solve the following problems in your textbook.

1. 7-18. A 208-V. six-pole, Y-connected, 25-hp, design class B induction motor is tested in the laboratory, with the following results:

   No load: 208 V, 22.OA, 1200 W, 60 Hz
   Locked rotor: 24.6 V, 64.5 A, 2200W, 15 Hz
   DC: 13.5 V, 64A

   Find the equivalent circuit of this motor, ~~and plot its torque-speed characteristic curve.~~

2. 7-24. Answer the following questions about a 460-V, Δ-connected, two-pole, 100-hp, 60-Hz, starting code letter F induction motor:

a) What is the maximum current starting current that this machine's controller must be designed to handle?

b) If the controller is designed to switch the stator windings from a connection to a Y-connection during starting, what is the maximum starting current that the controller must be designed to handle? (This means that the motor will start Y-connected and later switch to the normal Δ.)

c) If a 1.25:1 step-down autotransformer starter is used during starting. what is the maximum starting current that it must be designed to handle? (This is <u>instead of</u> the Y-connected start)

The following problems are not from your textbook

3. How can you reverse a capacitor-start motor?

   a) Reverse the leads to the capacitor. b) Reverse the positions of the capacitor and the start (second) winding.

   c) Reverse the leads to the main winding. d) Reverse the leads to the start winding.

   e) Reverse the leads to both the main and the start windings.

   Will this also work for a capacitor-run motor?

4. A 1/4-hp 120-V split-phase motor draws at the instant of starting a current of 4 A in its starting winding, while the main winding current takes 5. A, lagging the supply voltage by 15° and 45°. respectively. At startup. deter mine:

   a) the line current and power factor, and

   b) the in-phase components of the currents with the supply voltage.

5. A capacitor is added to the starting winding of the motor in the previous problem, with the result that its current now leads the voltage by 40°. The main winding remains as is.

   a) With this added capacitor, determine at the instant of starting the line current and the power factor.

   b) Compare the line current to that calculated in problem 4

   c) The motor starting torque is proportional to the sine of the angle between the winding currents. It is also proportional to the magnitudes of the currents. How much bigger is the strarting torque with the additional capacitor?

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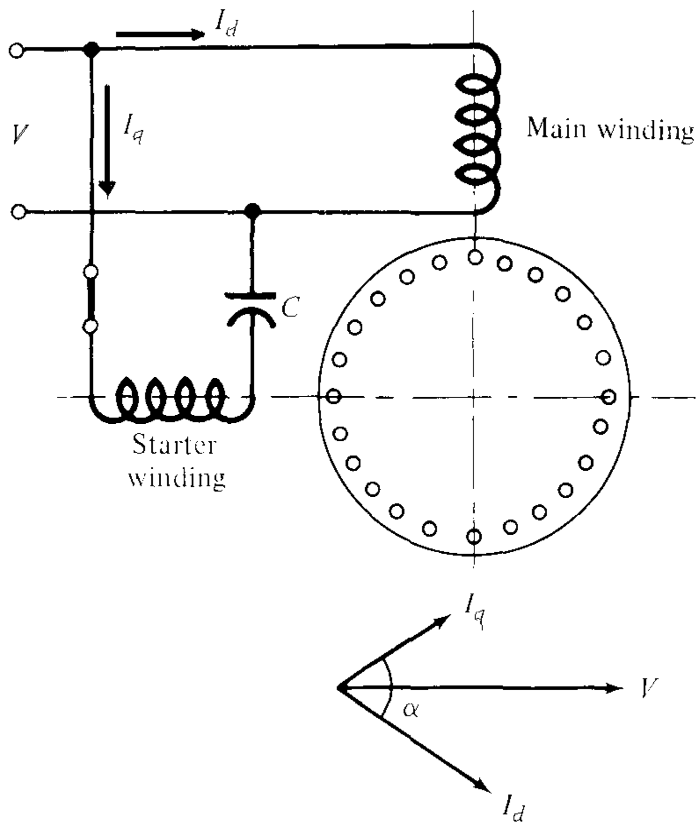
6. Measured at 60 Hz, the two windings of a single-phase motor have the following impedances:

   main winding: $\mathbf{Z_m} := (3.1 + 2.9 \cdot j) \cdot \Omega$

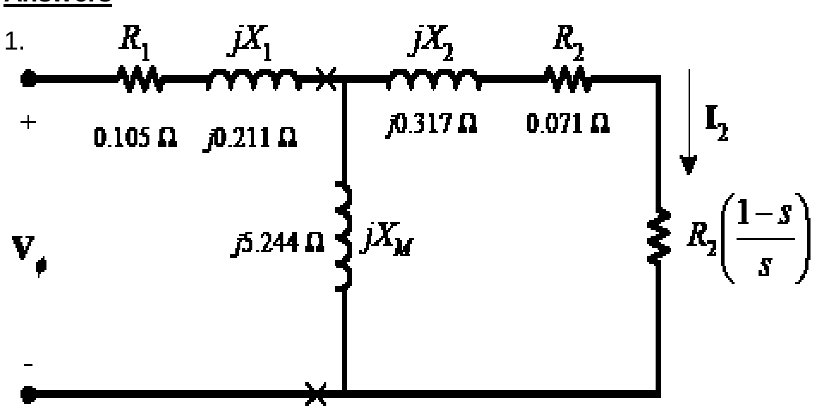
   starter winding: $\mathbf{Z_s} := (7.0 + 3.1 \cdot j) \cdot \Omega$

   Find the capacitor size that will produce the phase angle $\alpha = 90°$.



Answers

1.



2. a) $703 \cdot A$ b) $234 \cdot A$ c) $450 \cdot A$
3. d & d yes
4. a) $9.48 \cdot A$ 0.84 lagging
   b) $4.10 \cdot A$ $3.86 \cdot A$
5. a) $6.85 \cdot A$ 0.95 lagging
   b) Almost 28% less
   c) 1.58 times bigger
6. $251 \cdot \mu F$