ECE 3600 homework # 16 Due: Fri, 11/13/09 b

Solve the following problems in your textbook, starting on p.348.

1. 7-1. A DC test is performed on a 460-V, Δ-connected, 100-hp induction motor. If $V_{DC} = 21V$ and $I_{DC} = 72A$, what is the stator resistance R_1? Why is this so?

   Hint: Think about a single DC source hooked to a Δ connection.

2. 7-7. A 208-V. four-pole, 60-Hz, Y-connected, wound-rotor induction motor is rated at 15 hp. Its equivalent circuit components are

   $R_1 := 0.220 \cdot \Omega$ $R_2 := 0.127 \cdot \Omega$

   $X_1 := 0.430 \cdot \Omega$ $X_2 := 0.430 \cdot \Omega$ $X_M := 15 \cdot \Omega$

   $P_{mech} := 300 \cdot W$ $P_{misc} := 0 \cdot W$ $P_{core} := 200 \cdot W$

   For a slip of 0.05, find

   a) The line current To get the book answers (which are the answers that I gave you), Do not include Pcore in your calculation of the line current. Assume there is no Rc in the equivalent circuit.

   b) The stator copper losses P_{SCL}

   c) The air-gap P_{AG}

   d) The power converted from electrical to mechanical form P_{conv}

   e) The induced torque τ_{ind}

   f) The load torque τ_{load}

   Use P_{core} here. Lump it in with the mechanical losses, P_{misc} and P_{mech}. Read the last 2 paragraphs on p.302.

   g) The overall machine efficiency η

   h) The motor speed in revolutions per minute and radians per second

3. 7-8. For the motor in Problem 7-7,

   a) what is the slip at the pullout torque?

   b) What is the pullout torque of this motor?

4. 7-9 Use Matlab, a spreadsheet, or the program or method of your choice to:

   a) Calculate and plot the torque-speed characteristic of the motor in Problem 7-7.

   b) Calculate and plot the output power versus speed curve of the motor in Problem 7-7.

5. 7-10. For the motor of Problem 7-7, how much additional resistance (referred to the stator circuit) would it be necessary to add to the rotor circuit to make the maximum torque occur at starting conditions (when the shaft is not moving)? Plot the torque-speed characteristic of this motor with the additional resistance inserted.

6. 7-11 (partial) If the motor in Problem 7-7 is to be operated on a 50-Hz power system, what must he done to its supply voltage? Why?

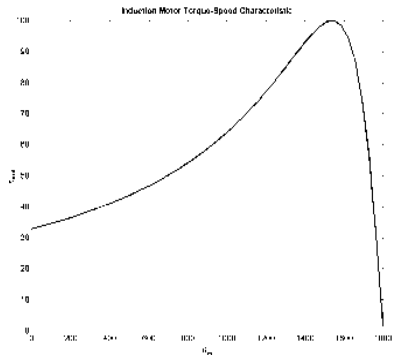
Answers

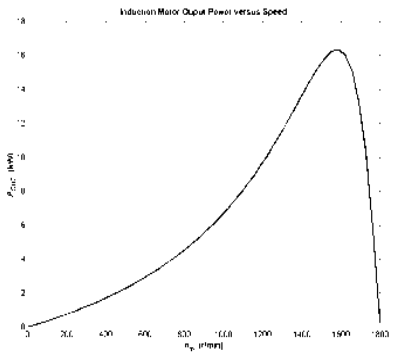
1. $0.437 \cdot V$

2. a) $42.3 \cdot A \angle -25.7 \cdot deg$ b) $1180 \cdot W$ c) $12.54 \cdot kW$ d) $11.92 \cdot kW$ e) $66.5 \cdot N \cdot m$ f) $63.8 \cdot N \cdot m$ g) $88.2 \cdot \%$ h) $1710 \cdot rpm$ $179 \cdot \frac{rad}{sec}$

3. a) $14.5 \cdot \%$ b) $100 \cdot N \cdot m$

4. a) b)





5. $0.749 \cdot \Omega$ more
   Plot looks like R_5 plot on Fig 7-31, peaking at about 100Nm

6. Decrease applied voltage to $\frac{5}{6}$ of value at 60Hz.
   Otherwise core will saturate.