3-phase Induction motors 2

bx

Name _____ ECE 3600 homework Ind2

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

1. 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

$N_{poles} := 4$ $R_1 := 0.220 \cdot \Omega$ $R_2 := 0.127 \cdot \Omega$

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

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

   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 P_{core} in your calculation of the line current. Assume there is no R_C in the equivalent circuit.

   b) The stator copper losses

   c) The air-gap P_{AG}

   d) The power converted from electrical to mechanical form

   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

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

2. 7-8. For the motor in Problem 7-7,
   a) what is the slip at the pullout torque? Find $\mathbf{V_{Th}}$ and $\mathbf{Z_{Th}}$ as part of your solution, you will need them again in problem 3, which you may want to read before finding these by hand.

b) What is the pullout torque of this motor?

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3. 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. Attach Plots as
   b) Calculate and plot the converted power versus speed curve of the motor in Problem 7-7. separate pages

4. 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.

5. 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?

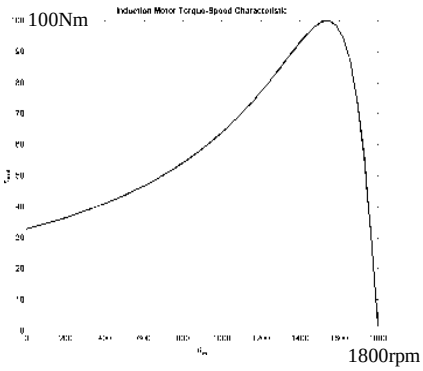
Answers 1. a) $42.3 \cdot A \angle -25.7 \cdot deg$ b) $1180 \cdot W$ c) $12.54 \cdot kW$ d) $11.92 \cdot kW$ e) $66.5 \cdot N \cdot m$ f) $63.8 \cdot N \cdot m$
g) $83.2 \cdot \%$ h) $1710 \cdot rpm$ $179 \cdot \frac{rad}{sec}$

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

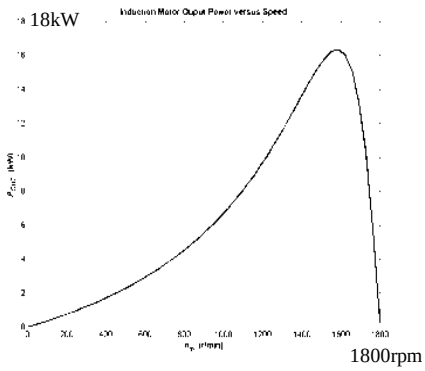
4. $0.749 \cdot \Omega$ more
   Plot looks like R_5 plot on Fig 7-31, peaking at about 100Nm

5. Decrease applied voltage to 5/6th of value at 60Hz.
   Otherwise core will saturate.

3. a)



b)



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