

## 3-phase Induction motors 2

bx

Name \_\_\_\_\_ ECE 3600 homework Ind2 Due: Sat, 10/26/24

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

$$N_{\text{poles}} := 4$$

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

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

$$X_1 := 0.430 \cdot \Omega$$

$$X_2 := 0.430 \cdot \Omega$$

$$X_M := 15 \cdot \Omega$$

$$P_{\text{mech}} := 300 \cdot \text{W}$$

$$P_{\text{misc}} := 0 \cdot \text{W}$$

$$P_{\text{core}} := 200 \cdot \text{W}$$

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  $P_{\text{core}}$  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  $P_{\text{AG}}$

d) The power converted from electrical to mechanical form

e) The induced torque  $\tau_{\text{ind}}$

f) The load torque  $\tau_{load}$

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  $V_{Th}$  and  $Z_{Th}$  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?

**ECE 3600 homework Ind2 p3**

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

Attach Plots as 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)  $42.3 \cdot A \angle -25.7 \cdot \text{deg}$       b) 1180-W      c) 12.54-kW      d) 11.92-kW      e) 66.5-N·m      f) 63.8-N·m

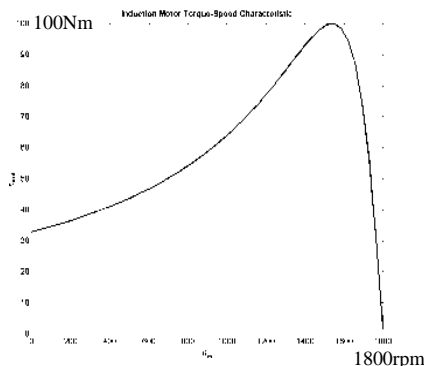
g) 83.2-%      h)  $1710 \cdot \text{rpm}$   $179 \cdot \frac{\text{rad}}{\text{sec}}$

2. a) 14.5-%      b) 100-N·m

4. 0.749-Ω more  
Plot looks like  $R_s$  plot on Fig 7-31, peaking at about 100Nm

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

3. a)



b)

