

Name _____

3-phase Induction motors 1

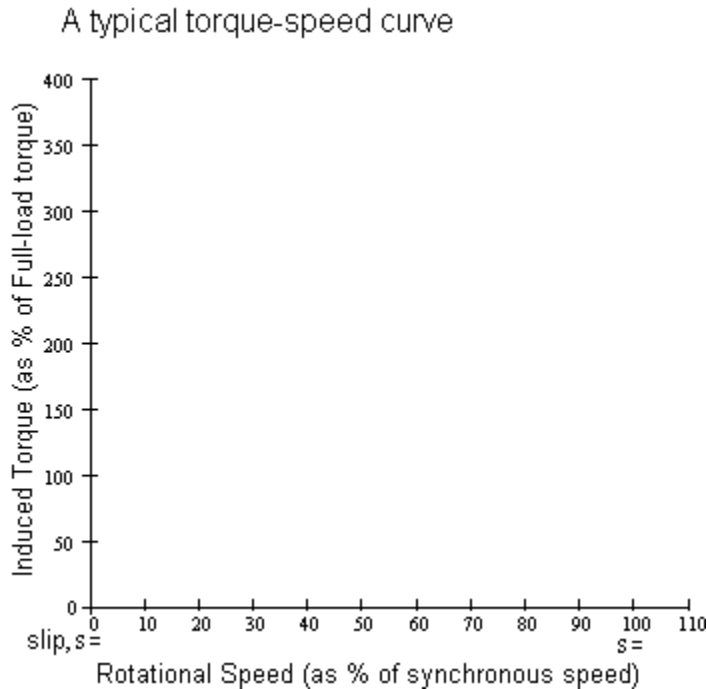
Due: Thur, 10/24/24

Answer the following questions in your textbook, starting on p.347.

7-1. What are slip speed and slip in an induction motor?

7-3. Why is it impossible for an induction motor to operate at synchronous speed?

7-4 Sketch and explain the shape of a typical induction motor torque-speed characteristic curve.



7-5. What equivalent circuit element has the most direct control over the speed at which the pullout torque occurs?

7-9. Why is the efficiency of an induction motor (wound rotor or squirrel cage) so poor at high slips?

7-16. Two 480-V, 100-hp induction motors are manufactured. One is designed for 50-Hz operation. and one is designed for 60-Hz operation, but they are otherwise similar. Which of these machines is larger?

7-17. An induction motor is running at the rated conditions. If the shaft load is now increased, how do the following quantities change?

- a. Mechanical speed _____
- b. Slip _____
- c. Rotor induced voltage _____
- d. Rotor current _____
- e. Rotor frequency _____
- f. Synchronous speed _____

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

1. 7-3 A 480-V three-phase four-pole 60-Hz induction motor is running at a slip of 0.025. Find:

- a) The speed of the magnetic fields in revolutions per minute
- b) The speed of the rotor in revolutions per minute
- c) The slip speed of the rotor
- d) The rotor frequency in hertz

2. Like 7-4 A three-phase 60-Hz induction motor runs at 710 rpm at no load and at 670 rpm at full load.
- How many poles does this motor have?
 - What is the slip at rated load?
 - What is the speed at one-quarter of the rated shaft torque? (You may assume the torque-speed curve is linear in this region).
 - What is the rotor's electrical frequency at one-quarter of the rated shaft torque?
3. 7-5 A 50-kW 440-V 50-Hz two-pole induction motor has a slip of 6 percent when operating at full-load conditions. At full-load conditions, the friction and windage losses are 520 W, and the core losses are 500 W. Find the following values for full-load conditions:
- The shaft speed n_m
 - The output power in watts
 - The load torque load τ_{load} in newton-meters
 - The induced torque τ_{ind} in newton-meters
 - The rotor frequency in hertz
4. A three-phase 60-Hz two-pole induction motor runs at a no-load speed of 3580 r/rpm and a full-load speed of 3440 r/rpm. Calculate the slip and the electrical frequency of the rotor at no-load and full-load conditions. What is the speed regulation of this motor [Equation (4-57)]?

Answers

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|----------------|-------------|------------|------------|---------|
| 1. a) 1800·rpm | b) 1755·rpm | c) 45·rpm | d) 1.5·Hz | |
| 2. a) 10 | b) 6.94·% | c) 700·rpm | d) 1.67·Hz | |
| 3. a) 2820·rpm | b) 50·kW | c) 169·N·m | d) 173·N·m | e) 3·Hz |
| 4. 0.56·% | 0.33·Hz | 4.44·% | 2.67·Hz | 4.1·% |