ECE 385 – Fall 2024

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HW #5

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Problem 1

A 3φ, 10 hp, 208 V, six-pole, 60 Hz, wound-rotor induction machine has a stator-to-rotor turns ratio of 1:0.5 and both stator and rotor windings are connected in wye (Y).
The stator of the induction machine is connected to a 3φ, 208 V, 60 Hz supply, and the motor runs at 1140 rpm.

a. Determine the operating slip.
b. Determine the voltage induced in the rotor per phase and frequency of the induced voltage.
c. Determine the rpm of the rotor field with respect to the rotor and with respect to the stator.

Problem 2

A 3φ, 460 V, 60 Hz, 20 kW induction machine draws 25 A at a power factor of 0.9 lagging when connected to a 3φ, 460 V, 60 Hz power supply. The core loss is 900 W, stator copper loss is 1100 W, rotor copper loss is 550 W, and friction and winding loss is 300 W. Calculate:

a. The air gap power, P_{ag}
b. The mechanical power developed
c. The output horsepower
d. The efficiency

Problem 3

A 3φ, 10 hp, 460 V, 60 Hz, 4-pole induction motor runs at 1730 rpm at full-load. The stator copper loss is 200 W and the windage and friction loss is 320 W. Determine

a. The mechanical power developed, P_{mech}.
b. The air gap power, P_{ag}.
c. The rotor copper loss, P_{cu2}.
d. The input power, P_{in}.
e. The efficiency of the motor.

Problem 4

The following test results are obtained for a 3φ, 280 V, 60 Hz, 6.5 A, 500 W induction machine.

Blocked-rotor test: 44 V, 60 Hz, 25 A, 1250 W
No-load test: 208 V, 60 Hz, 6.5 A, 500 W

The average resistance measured by a dc bridge between two stator terminals is 0.54 Ω.

a. Determine the no-load rotational loss.
b. Determine the parameters of the IEEE equivalent circuit and draw the circuit diagram.
c. Determine the output horsepower at s = 0.1.