ECE 385 – Fall 2024

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HW #7

Due Date: Uploaded to D2L by 10 PM Friday December 6, 2024

Problem 1 (10 points)

A 3 φ, 10 kVA, 220 V, Y-connected synchronous generator has R_a = 0.25 Ω per phase and X_s = 5.0 Ω per phase. Determine the excitation voltage, E_f, when the generator is delivering full load at power factor of

a) 0.85 lagging.
b) unity.
c) 0.8 leading.

Problem 2 (10 Points)

A 3φ, 14 kV, 10 MVA, 60 Hz, two-pole, 0.85 PF lagging, Y-connected, synchronous generator has X_s = 20 Ω per phase and R_s = 2 Ω per phase. The generator is connected to an infinite bus.

a) Determine the excitation voltage at the rated condition. Draw the phasor diagram for this condition.
b) Determine the power (torque) angle at the rated condition.
c) If the field current is kept constant, determine the maximum power the generator can supply.

Problem 3 (30 points)

Research the Northeast blackout of 2003 discussed in class. Briefly explain the following:

a) What caused the outage?
b) What factors contributed to the duration and size of the outage?
c) How did the use of the Infinite Bus (or grid) system studied in class contribute to the outage and/or limit the outage?
d) What learnings came from the outage related to technical, operational, and ethical considerations for engineers?