

## ECE 333

Second Exam – Spring 2000 – Closed book, closed notes, class sheet, 55 minutes

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### Problem #1 (25 points)

Given the following laboratory data for a 3-phase, 60 HZ, 4 pole, 230 V (line-to-line), round rotor, Y-connected synchronous generator:

Open circuit test: Field current = 3 Amp, Terminal voltage = 230 V (line-to-line)

Short circuit test: Field current = 2 Amp, Terminal line current = 8 Amp

- (a) What value of field current do you need to produce rated voltage when serving a load of 3,000 W (three phase) at unity power factor? Neglect armature resistance.
  - (b) How much torque does the prime mover have to deliver to serve this load (in Newton-Meters)?
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### Problem #2 (25 points)

Given the following laboratory data for a 3-phase, 60 HZ, 2 pole, round rotor, Y-connected synchronous motor connected to a 480 V (line-line) source:

When the field current is zero, the armature line current is 40 Amps.

When the field current is 4 Amps, the armature line current is zero.

- (a) Find the field current needed to make the power factor 1.0 when it is loaded to 40 kW (three phase). Neglect armature resistance.
- (b) What is the absolute maximum power this motor can deliver when the field current is 4 Amps?

**(OVER)**

Problem #3 (25 points)

An unloaded self-excited shunt D.C. generator with  $R_a = 5$  Ohms is tested at 1200 RPM. The test results are:

Field current equal to zero, terminal voltage is equal to 10 V.

Field current equal to 1 Amp, terminal voltage is equal to 120 V.

- (a) What value of total field resistance is needed to keep the terminal voltage at 120 V if the speed drops to 1050 RPM when a 30 Ohm load resistor is applied to the terminals?
  - (b) If this value of resistance is used, will the actual voltage be higher or lower than 120 V? Explain your answer.
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Problem #4 (25 points)

Given that a 240 V shunt D.C. motor with 4 Ohms armature resistance comes to a no-load speed of 1257 RPM when the total shunt field resistance is 80 Ohms:

- (a) What is the no-load speed if the total shunt field resistance is increased to 100 Ohms?
- (b) How fast will it go when you load it down with a torque of 20 NM (with the 100 Ohms total shunt field resistance)?

(Neglect residual voltage and assume 240 V is applied)