

ECE 333

Final Exam – Spring 2000 – Closed book, closed notes, 3 hours

One formula sheet is provided separately. Work all problems in exam book provided.

Problem #1 (30 points)

A balanced 3-phase, ABC sequence source serves a balanced, 3-phase load of total power equal to 1500 Watts plus 1500 VARS. A wattmeter is wired such that the voltage input measures the voltage drop from A to B and the current into line C of the load. What will the wattmeter read?

Problem #2 (35 points)

A 7200/240 Volt single-phase transformer is rated at 50 kVA.

- (a) Compute a %Z that will limit the short circuit current to 4000 Amps on the 240 Volt side when it is supplied with rated voltage on the 7200 Volt side.
 - (b) With this %Z, what is the load voltage when the load current is rated current at 0.8 power factor lag (with respect to the load voltage). Rated voltage is applied to the 7200 Volt side. Neglect resistance.
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Problem #3 (30 points)

A balanced 3-phase source of 480 Volts (line-line) serves a balanced 3-phase, 3-wire load of 6000 Voltamps (3 phase) at 0.8 power factor lag (60Hz).

- (a) What is the source line current?
- (b) What value of capacitance should be added in a delta across the load to minimize the source line current?
- (c) What is the minimum source line current using this capacitance?

(OVER)

Problem #4 (35 points)

A 230 Volt (line-line), 60Hz, 3-phase, 6 pole induction motor has a speed of 1100 RPM at a load torque of 8 NM.

- (a) What is the frequency of the rotor currents at this speed?
 - (b) Estimate the “full voltage” starting current
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Problem #5 (35 points)

A Y-connected, 3-phase, 6 pole, round rotor synchronous machine with negligible stator resistance is connected to a 208 Volt (line-line) ideal source. The excitation is adjusted so that at a full-load generator power of 3730 Watts (3-phase), the torque angle is 30 degrees (electrical). With zero input torque from the shaft the line current is 5 Amps and the machine absorbs 1800 VARS (3 phase)..

By what percentage should the excitation be increased to make the machine run at unity power factor while providing this 3730 Watts?

Problem #6 (35 points)

A 240 Volt shunt dc motor is driving a 208 Volt (line-line), 5 HP, 3-phase, 60 Hz, 4-pole synchronous generator. At no load, the dc machine shunt field current is adjusted to 3 Amps to achieve rated speed and the synchronous machine field current is adjusted to 2 Amps to achieve rated voltage. At full load (5 HP - unity power factor), the dc machine shunt field current must be adjusted to 2.8 Amps to achieve rated speed and the synchronous machine field current must be adjusted to 3 Amps to achieve rated voltage.

- (a) What is the dc machine armature resistance? Neglect residual voltage.
- (b) What is the synchronous machine synchronous reactance?