ECE 333

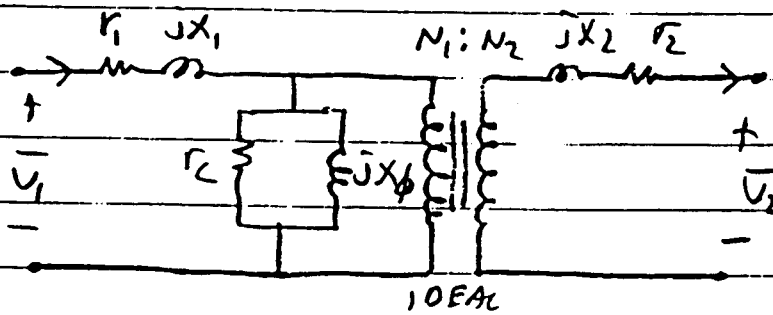
FINAL EXAM — SPRING 1995

3 Hours, closed book, closed notes, open mind

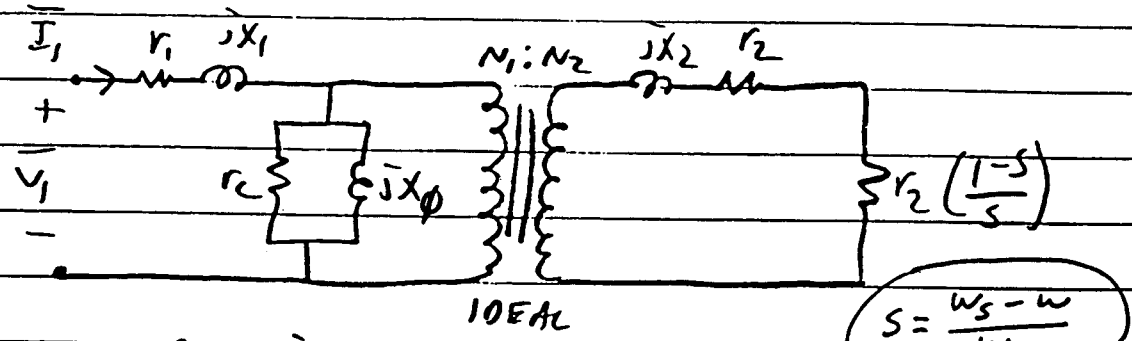
Given information:

$$P_{3\phi} = \sqrt{3}\, V_{LL} I_L \cos\phi$$

Transformer

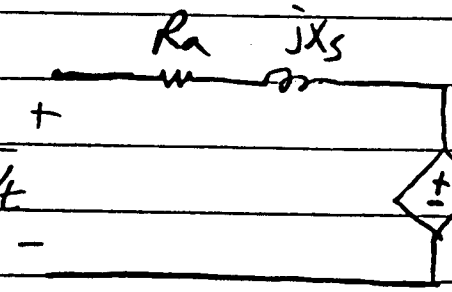


Induction

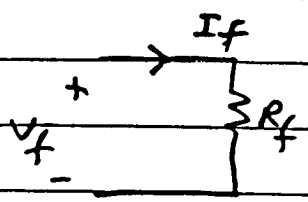


$$s = \frac{\omega_s - \omega}{\omega_s}$$

Synchronous



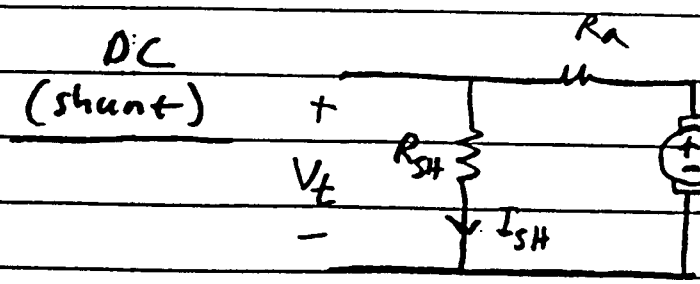
$$(\delta_t = \delta - \angle \bar{V}_t)$$



$$P_{IN_{3\phi}} = \frac{3|\bar{V}_t||\bar{E}_f|}{X_s}\sin(-\delta_t)$$

$$Q_{IN_{3\phi}} = \frac{3|\bar{V}_t|^2}{X_s} - \frac{3|\bar{V}_t||\bar{E}_f|}{X_s}\cos(-\delta_t)$$

DC (shunt)



$$T = \frac{P}{\omega}$$

ECE 333

Final Exam - Spring 1995 - Closed book (official course sheet allowed)

Problem points (out of 100) are indicated. Work all problems in exam booklets.

Problem #1 (16 points)

Given: A 240/120 volt 1.0 KVA, 8% impedance transformer.
(neglect resistance and core losses)

Find: (a) Describe the open-circuit test (i.e. what side is energized/metered etc) and indicate what values of each measurement you would expect to get.

(b) Describe the short-circuit test (i.e. what side is energized/metered etc) and indicate what values of each measurement you would expect to get.

Problem #2 (16 points)

Given: Three identical 7200/120 volt (l-n) transformers are connected in a 4 wire Y-Y connection and excited with 110% of rated voltage. The primary current in phase A at no load contains 1.0 amp of fundamental frequency and 0.4 amps of 3rd harmonic.

Find: (a) What is the neutral current at no load for this given condition?

(b) What are the primary phase A and neutral currents when the transformer bank is loaded to 30 KVA (3 phase) at unity power factor with 110% primary voltage?

Problem #3 (16 points)

Given: A 230 volt (l-l) balanced, symmetrical, 3 phase, 6 pole, 60 Hz, induction motor has a magnetizing reactance of 34 ohms (referred to the stator) and a rotor resistance of 2 ohms (referred to the stator). At a speed of 1150 RPM,

Find: (a) what is the magnitude of the stator line current?

(b) what is the torque to the shaft?

(OVER)

Problem #4 (16 points)

Given: A 480 volt (l-l) balanced, symmetrical, 3 phase, 6 pole, 60 Hz, synchronous motor is initially unloaded. Its excitation is adjusted so that the line current is zero. At this excitation, it can deliver a maximum total 3 phase power of 8,000 watts without losing synchronism. With this excitation, it is loaded to 4,000 watts (3 phase).

Find: (a) The total 3 phase reactive power into the motor from the source.

(b) The line current magnitude.

Problem #5 (16 points)

Given: A 240 volt shunt dc motor is driving a 208 volt (l-l), 5 HP balanced, symmetrical, 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 (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.

Find: (a) What is the dc machine armature resistance?

(b) What is the synchronous machine synchronous reactance?

Problem #6 (20 points)

Given: A 230 volt (l-l), balanced, symmetrical, 3 phase, 6 pole, 60 Hz, induction motor is driving a self-excited shunt dc generator. At no load, the dc generator terminal voltage is 240 volts, and the induction motor line current is 4 amps (essentially zero power factor). When the generator is loaded to 10 amps, its terminal voltage drops to 220 volts.

Find: (a) Briefly describe 3 reasons why the voltage dropped.

(b) Estimate the magnitude of the induction motor line current when loaded as above.