Portland State University
Electrical & Computer Engineering
EE 347 Power Systems I

-Homework #3-

Text Questions: 3-13, 3-19

Text Problems: 3-2(a,c,d), 3-21(b,c)

Problem 1:

Expand your power system simulation from Homework #2 by replacing the 13.2kV transmission line with a 138kV line. Correspondingly, transformers are now required at the load and generator[1]. System specifications:

- 13.2kV load bus
  - Load 1: 430kVA, PF = 0.70 lagging
  - Load 2: 300kVA, PF = 0.85 lagging
- Transmission line:
  - 0.80MVA capacity
  - R = 0.02Ω/mile, X = 0.2Ω/mile[2]
  - d = 80 miles
  - 138kV
- 24.2kV generator bus; set as 'system slack bus'
  - Generator: 0.9MW, 0MVAR (these will change when the simulation runs)
- Transformers
  - 24.2kV-138kV step-up (generator)
  - 138kV-13.2kV step-down (load)
  - 800kVA rating
  - Series resistance, 0.01pu[3]
  - Series reactance, 0.03pu
  - Shunt Charging, -0.001pu ($B = 1/jX_m$ from Chapman, in per-unit form)
  - Shunt Conductance, 0.0005pu ($G = 1/R_C$ from Chapman, in per-unit form)

Run a "Single-Solution Full Newton" simulation. Turn in a printout of your simulated power system circuit. Determine the percentage of the transmission line and transformer MVA rating used by the system. Calculate the generator-to-load real power transmission efficiency. Are system components, transmission line and transformers, properly sized?

---

[1] In PowerWorld, transformers are connected like transmission lines except that the buses on either end are of differing voltages. Adding transformers will also require the addition of new generator and load buses.

[2] Per-mile R and X may be set within the line information dialogue box by clicking on the 'Calculate Impedances >" button and selecting "from per distance impedances."

[3] We will learn more about the per-unit system of representation later in the term.

Problem 2:

Open-circuit and short-circuit tests were performed on the primary side of a 75 kVA, single-phase 7.20 kV-240 V distribution transformer. Determine the primary-side cantilever equivalent circuit for the transformer.

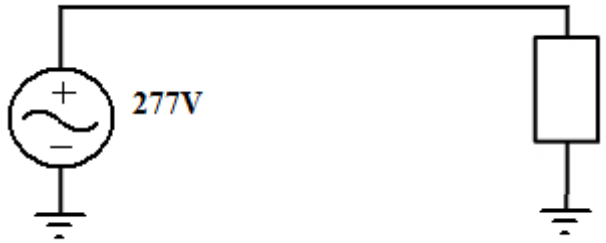
Test data are presented in Table 1. Determine the voltage regulation and transformer efficiency when a rated load with 0.85 lagging PF is connected. Voltage regulation is load regulated.

Table 1 Short-circuit and open-circuit test data

$V_{OC} = V_{p,Rated}$	$I_{OC} = 250$ mA	$P_{OC} = 1500$ W
$V_{SC} = 330$ V	$I_{SC} = I_{p,rated}$	$P_{SC} = 1600$ W

Fundamentals of Engineering Exam Problem 1:

The 50 kW load in the circuit below has a lagging power factor of 0.77. What size capacitor must be added to this circuit to correct the power factor to 0.95 lagging?



(A) -48kVAr in series
(B) -25kVAr in series
(C) -48kVAr in parallel
(D) -25kVAr in parallel