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

-Homework #2-

Text Questions: 3-1 through 3-5

Text Problems: none

Problem 1:

Download and install PowerWorld Simulator.

Build a simple power system consisting of two buses, two loads, a transmission line and a synchronous generator. Apply the following parameters:

- 13.2kV load bus
- Load 1: 280kVA, PF = 0.85 lagging
- Load 2: 350kVA, PF = 0.91 lagging
- Transmission line: 0.80MVA, R = 0.06Ω/mile, X = 0.2Ω/mile[1], d = 80 miles
- 13.2kV generator bus; set as 'system slack bus'
- Generator: 0.3MW, 0MVAR (these will change when the simulation runs)

Run a "Single-Solution Full Newton" simulation. Turn in a printout of your simulated power system circuit. Determine the percentage of the transmission line MVA rating used by the system and calculate the transmission efficiency:

$$\eta = \frac{P_{load}}{P_{gen}}$$

Problem 2:

The current drawn by fluorescent lighting has a high total harmonic distortion. For this case, THD is calculated to be 68%. The true power factor is measured to be 0.81 lagging. What is the displacement power factor (ie. if all harmonics could be filtered out)? Assume the source voltage waveform is undistorted.

[1] 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."

Problem 3:

Calculate the Total Harmonic Distortion (IEEE 519.1992) of the following current waveform. Use sufficient terms such that convergence is within 0.20%.

$$i_A(t) = -\frac{165.0A}{\pi}\sum_{n=1}^{\infty}\frac{1}{(2n-1)}\sin[2\pi(2n-1)(60Hz)t]$$ **Equation 1**

What waveform does Equation 1 represent? Generate an additive plot of the fundamental and harmonics over two periods of the fundamental. State its shape, peak value and frequency.

Problem 4:

A 120/240VAC feeder line supplies a residence. Because of the nature of the load, a significant quantity of harmonic current is produced. Analysis with a spectrum analyzer reveals the following continuous load current profile in the hot lines:

N	I_{RMS} (A)
1	62
2	31
3	18
4	9
5	7
6	2
7	0.5
8	0.25

- Calculate the THD of the current
- Calculate the expected RMS current in the hot lines
- Calculate the RMS current in the neutral line.

Size the hot and neutral (grounded) feeder lines according to the NFPA 70. Feeder lines are aluminum, THW, with a 75ºC temperature rating and contained within a raceway. Consider sizing when ambient temperature is 45˚C; apply the appropriate ambient temperature correction factor. Start with NEC Article 310.15.

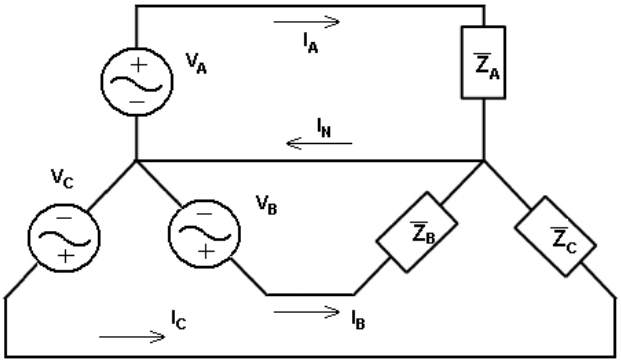
Fundamentals of Engineering Exam Problem 1 (NCEES):

For the circuit shown, the neutral current (A), $\mathbf{I}_N$ is most likely,

$\mathbf{V}_A = 277V\angle 0°$ $\quad\quad$ $\mathbf{Z}_A = 35\Omega$

$\mathbf{V}_B = 277V\angle 120°$ $\quad\quad$ $\mathbf{Z}_B = 30+j15\Omega$

$\mathbf{V}_C = 277V\angle 240°$ $\quad\quad$ $\mathbf{Z}_C = 21-j19\Omega$



(A) 5.6<109°
(B) 2.3<110°
(C) 0
(D) 9.6<-8°