Electrical Circuits II Lab 3 Online – Three-Phase Power Systems

Objectives

Analyze balanced and unbalanced three-phase power generation, transmission, and consumption systems using LTspice.

Preparation

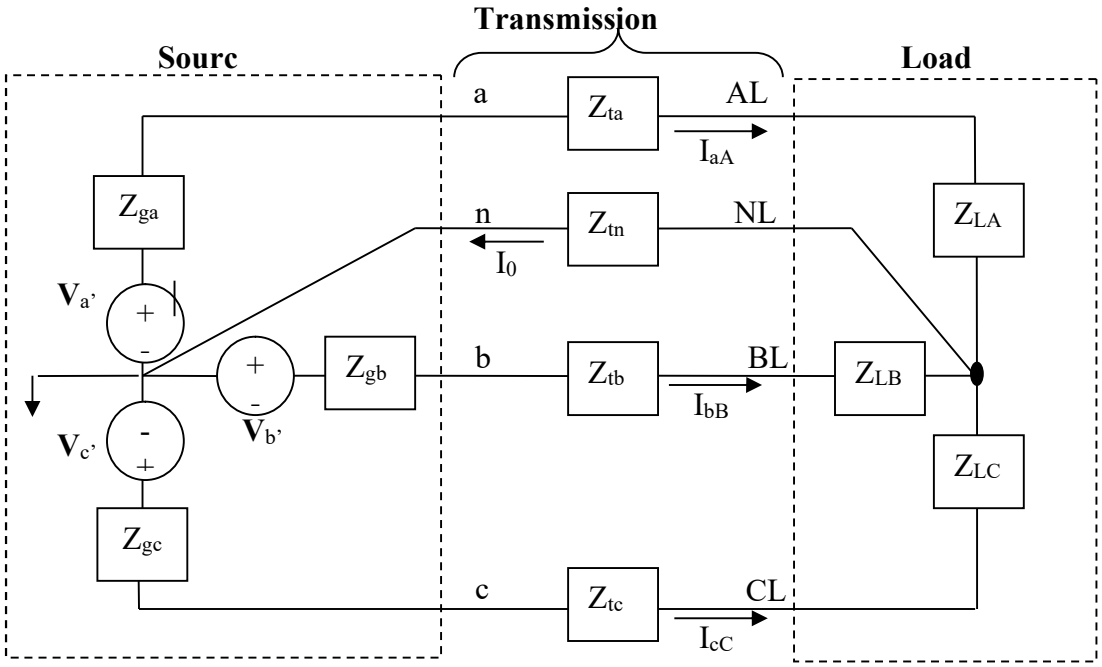
Complete the following steps before starting to work on the experiments in this lab:

1) Complete Lab 2 and associated report.
2) Complete lecture, homework, and videos in FEC Chapter 11 "Three-Phase Balanced Circuit".

Experiment 1

Implement the following balanced abc sequence three-phase power generation, transmission, and consumption system in LTspice.

Generator Phase Voltage Magnitude = $|V_\varphi|$=100 kV running at 60 Hz
Generator Impedance: R_g = 100 Ω, L_g = 1 H
100 mile Transmission Impedance: : R_t = 82 Ω, L_t = .2 H
Load Impedance: R_L = 12 kΩ, L_L = 5 H



Notes :

1)Impedance (Z) components (C, L, R) are in series.

2) LTspice is not case sensitive so node labeled "a" will be connected to node labeled "A"

Create a table with all line and phase currents and voltages for this circuit at the load (peak and phase). Include the current through the neutral line in your analysis.

Experiment 2

Repeat experiment one when source voltage that is not balanced due to phase shift:

$Va' = V_\varphi \angle 0^\circ$

$Vb' = V_\varphi \angle -100^\circ$

$Vc' = V_\varphi \angle +110^\circ$

Create a table with all line and phase currents and voltages for this circuit (peak and phase). Include the current through the neutral line in your analysis.

Experiment 3

Compare and explain the difference between voltage and current values from experiment one and two.

Report Requirements

This lab and associated report must be completed individually. All reports must be computer printed (Formulas and Diagrams may be hand drawn) and at minimum:

For each experiment include:

- Clear problem statement in your words.
- Answer to any specific experiment questions (if any)
- Identify the theory or process and associated calculations
- Documents resulting circuit schematics from LTspice, simulation output and additional tables, timing diagram or chart required by the experiment.

For the whole report include:

- A Cover page with your name, class, lab and completion date.
- A Lessons Learned section which summarizes your learning from this lab in 5 sentences or more.
- A New Experiment section that has description of a new experiment and the experiment's results. Experiment should be related to material covered in class but not simply variation of the existing lab experiments.