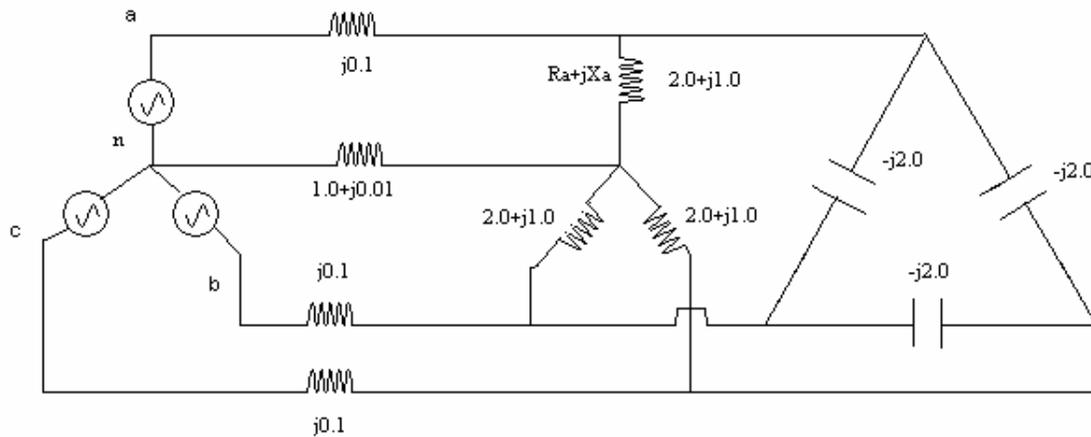


ELEN 460
Computer Laboratory Exercise No: 1
Power Calculations

Objective: Verify power calculations by simulating three phase circuit operation using Matlab Power System Blockset. Observe the differences between the balanced and unbalanced operation of three phase circuits. Gain insights about the concepts of instantaneous power, reactive power and three phase power for balanced and unbalanced circuit operation.



In the above circuit, assume that the three phase voltage sources are given as:

$$V_{an} = 1\angle 0^\circ, \quad V_{bn} = 1\angle -120^\circ, \quad V_{cn} = 1\angle 120^\circ, \quad \text{freq.} = 60\text{Hz.}$$

Procedure:

- a) Using ©Matlab’s Power System Blockset, build the electrical circuit shown above. You should use powerlib library and Simulink library to find the required components and measuring devices for your circuit.
- b) Using the library, make the necessary connections of measuring devices and function blocks (adder, multiplier, etc.) to obtain and plot the instantaneous power delivered by the three voltage sources in phases a, b and c on the same graph.
- c) Using the Fourier block, obtain the phasors for $V_{an}, V_{bn}, V_{cn}, I_{na}, I_{nb},$ and I_{nc} . Compute the real and reactive power delivered by the sources in each phase.
- d) Compare the real power values calculated in part c and the average (DC value) value of the waveforms in part b.
- e) Add up the waveforms in part b and plot the total three phase instantaneous power as a function of time. Mathematically show why this total power must be a constant.
- f) Now, change the resistance in phase a, as $R_a = 20\Omega$. Repeat parts b-e.

Report:

Show the complete diagram of your circuit, measurements and instrumentation. Provide a step by step account of the procedure you followed and the results you have obtained. Answer all questions appearing in any of the steps of the procedure.

Assuming the balanced case, i.e. ($R_a = 2\Omega$), answer the following:

1. What is the frequency of the per phase instantaneous power ($p_a(t)$, $p_b(t)$ and $p_c(t)$) when the voltage and current waveforms are 60 Hz? Derive the expression for the instantaneous power and verify your observation.
2. What is the frequency of the instantaneous three phase power $P_{total}(t)$? Discuss your answer both for balanced and unbalanced operation.

List all of the references you use in preparing the report. If you use any references, number them and refer to them within your report.