LAB MANUAL

Note:

- The Two Port Network lab should be completed using the available ULABS works software available for download. Please read the instruction notepad file attached with the software in zip folder and the software instruction after installation is complete.
- The Alternative Current Circuit Lab should be completed using the online Utech Virtual lab by clicking on the Alternative Current Circuit Lab portal.

University of Technology, Jamaica
School of Engineering
Electrical Networks 2

Alternating Current Circuits Fundamentals

Objectives: At the end of this laboratory exercise students should be able to

1. Use appropriate laboratory techniques and equipment to determine the voltage and phase relationships between series circuit elements
2. Determine the active power dissipated in an electric circuit by current measurement
3. Derive the apparent and reactive power within a circuit based on the measured values

Introduction

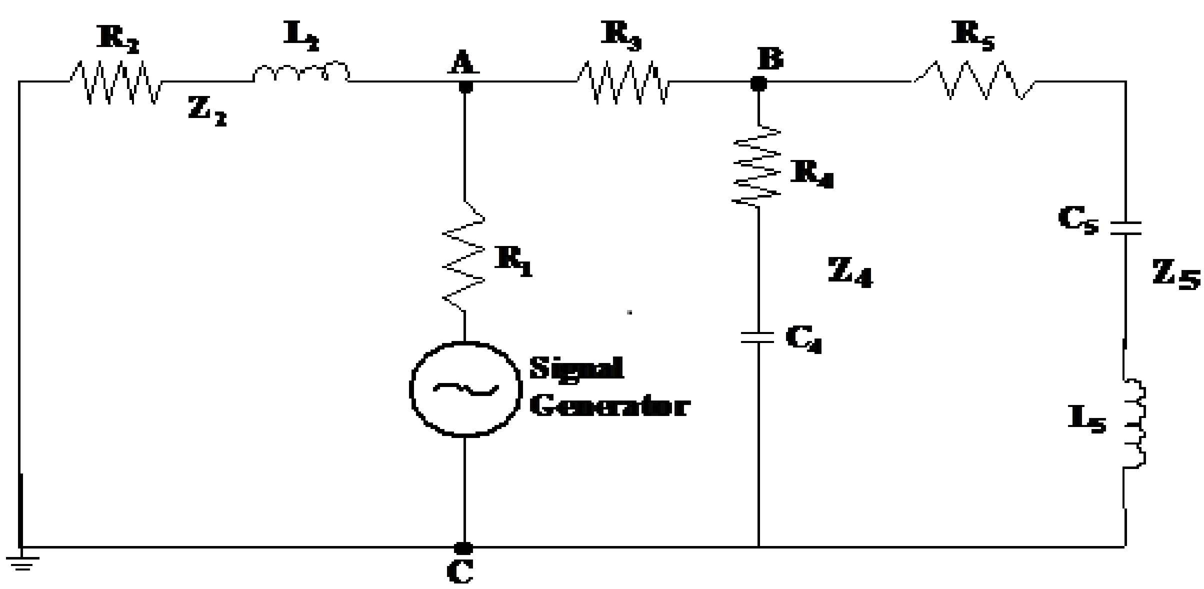
In order to fully describe the operation of alternating current circuits, it is necessary to know the magnitude as well as the phase relationships between the currents and voltages that are present. The standard methods of using analogue or digital multimeters for measurements must therefore be supplemented by the use of oscilloscopes or any other instrument deemed necessary.

In this laboratory exercise, students will be required to pull on their experience from Electrical Networks 1 to carry out voltage, current and phase measurements.

In contrast to the standard approach to laboratory exercises, students will be required to succinctly outline the methods by which each activity is carried out.

Getting started

All activities will be based on the electrical network shown below.



Apparatus

Signal Generator, Digital Multi-meter, Oscilloscope,
Impedances –

- Z_2 - (L_2 = 10 mH; R_2 = 40Ω)
- Z_4 – (C_4 = 3μF; R_4 = 80Ω)
- Z_5 – (L_5 = 30 mH, C_5 = 2μF, R_5 = 60Ω)
- R_3 = 150Ω
- R_1 = 100Ω

Instructions

1. Set and verify the frequency of the signal generator to 250 Hz.

2. Adjust its output until the voltage drop across points “AB” is 20V.

3. Measure the relevant branch voltages and currents:

    a. determine the phase relationships in the branches containing reactive elements;
    b. hence determine the active power dissipated
        i. based on the measured values
        ii. based on the nominal values
    c. use graphical sketches to show the phase relationships for impedances 2, 4 and 5

4. Determine the phase relationship between the supply current and voltage; hence determine the apparent power supplied to the circuit

5. Determine the current through each reactive element and use it to verify the reactive power derived from the measurements in steps 3 and 4

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Two-Port Networks

Objectives: At the end of this laboratory exercise students should be able to

1. Use appropriate laboratory techniques and equipment to determine the impedance and the admittance parameters of resistive two-port networks
2. Determine network parameters of interconnected networks
3. Use the derived parameters to determine the power dissipated in connected loads

Introduction

Network parameters are used to determine the relationship between the input and output voltages and currents. These relationships can be expressed as linear equations and hence facilitate the use of the superposition theorem to determine their individual values.

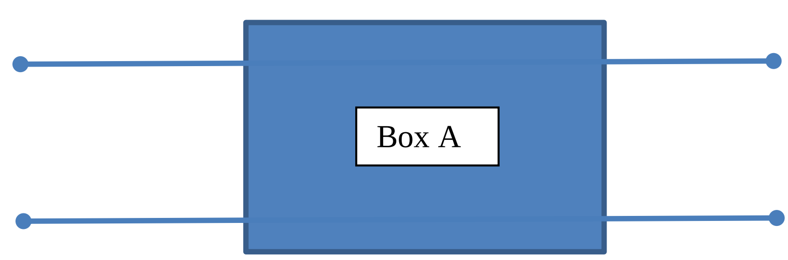
For given sets of network parameters conversion to other parameters can be determined by using standard transformation matrices.

In this laboratory exercise, students will be required to pull on their experience from Electrical Networks 1 to carry out voltage and current measurements using them to determine the parameter being considered.

In completing the laboratory exercise students will be required to succinctly and clearly outline the methods by which each activity is carried out.

Getting started

All exercises will be based on the two “black boxes” supplied to each group.



Apparatus

Voltage Supplies
Voltmeters
Ammeters
Ohmmeter
(Multimeters)
2 Black Boxes

Instructions

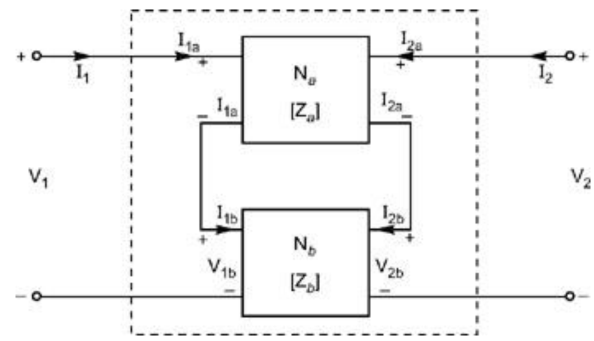
1. Label each black box as “A” and “B” and ensure that this nomenclature is maintained throughout the experiment.

2. Carryout appropriate measurements to determine the open circuit and short measurements on each black box and use your results to determine which of the black boxes are symmetrical or asymmetrical

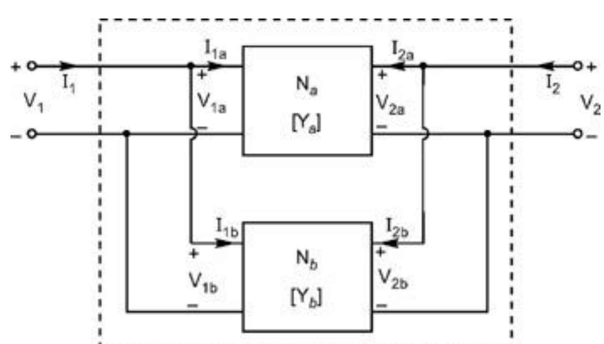
3. Determine, using appropriate measurements the admittance parameters of box "A" and the impedance parameters of Box "B"

4. Using the appropriate conversion matrix, determine the corresponding impedance and admittance parameters for boxes "B" and "A" respectively.

5. Connect box "A" in series with box "B" as shown below, and determine the impedance parameters of the combined network. What is the relationship between the impedance parameters of each network and that of the combined network?



6. Connect box "A" in parallel with box "B" as shown below, and determine the admittance parameters of the combined network. What is the relationship between the admittance parameters of each network and that of the combined network?



7. Connect box "A" in cascade with box "B" by connecting the output of network "A" to the input of network "B", and determine the transmission parameters of the combined network. What is the relationship between the transmission parameters of each network and that of the combined network?

8. Based on the impedance values determined for box "A" request a set of three resistors with values that are comparable to the input impedance parameter. Also request a load resistor of value approximately twice as large as the output impedance determined. Use your three resistors to form

   a. A "pi" network
   b. A "T" network

   Connect the voltage supply and set its value to 10V for each input network and determine the corresponding power dissipated in the load.

   Use appropriate calculations to verify the values measured for each connection above.