Bangladesh University of Engineering & Technology

Course : EEE 212

Course Title: Numerical Techniques Laboratory

A project on

Three Phase Circuit Analysis

Submitted by:	
Afsana Akter Popi ID:1806046	Mohammad Tahsin Alam ID:1806047
Submitted to:	
Dr. Muhammad Anisuzzaman Talukder Professor Department of EEE BUET	Shahed Ahmed Department of EEE BUET

Level: 2 **Term:** 1

Section: A2

Department: EEE

Date of Submission: 24 July, 2021

Introduction:

The project is about finding 3 phase circuit parameters. In a nutshell it is a project or can be used as an app for finding the desired parameters. Three phase circuits are basically a combination of three sources with phase difference of 120° between each other and three load impedances. The line loss here can be expressed by three line impedances. Depending on the connection of the sources and the load impedances, three phase circuits have four different combinations.

- ✧ **Wye-Wye**
- ✧ **Wye-Delta**
- ✧ **Delta-Wye**
- ✧ **Delta-Delta.**

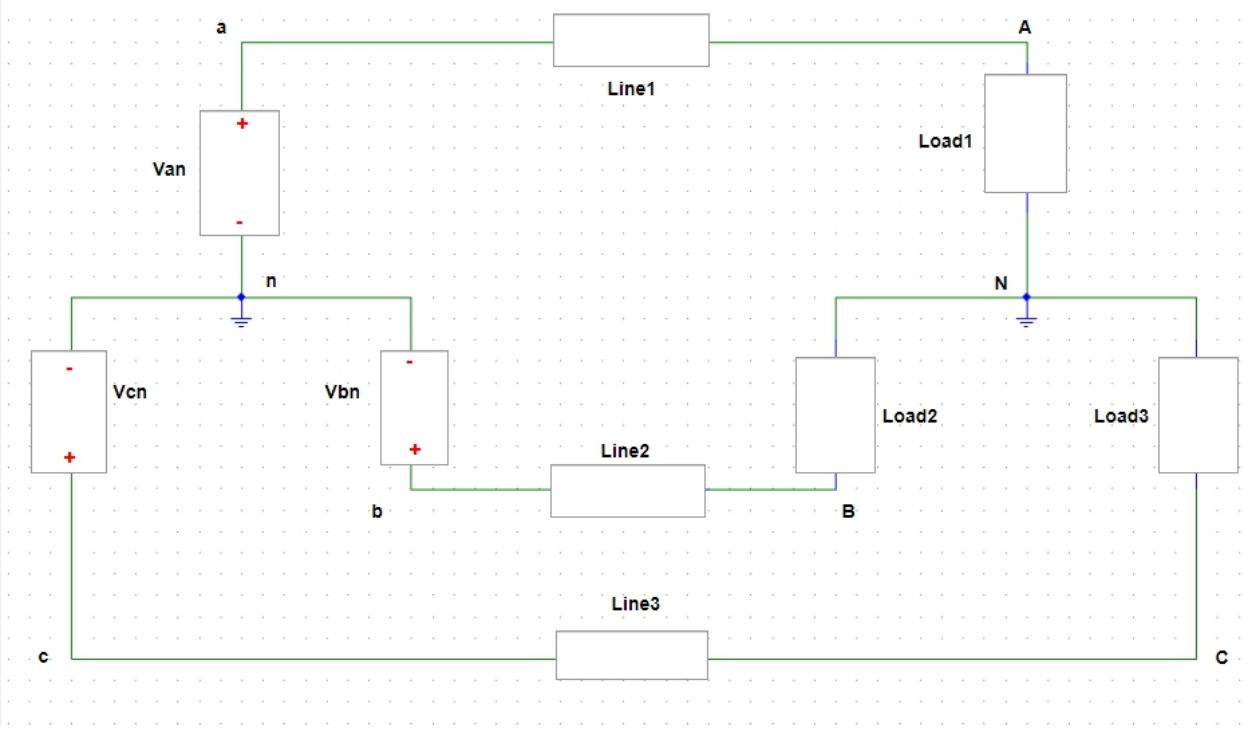
Our goal in this project is to create a three-phase circuit analyzer using MATLAB and GUI. We've created an analyzer app that takes inputs from the user in a graphic interface and returns the values of line currents, phase currents, line voltages, phase voltages, total power, real power, reactive power and power factor of the loads. This circuit analyzer works for both balanced and unbalanced three phase circuits.

Working principle:

For analyzing three phase circuits, some inputs need to be taken first from the user and then be analyzed and output is calculated. So, in this project, to acquire the desired output user first needs to provide the values of source voltages, load impedances, line impedances (reason behind line loss). As we know three phase circuits can be both balanced and unbalanced. To solve the circuits mesh equations are formed so we can solve both **balanced and unbalanced** circuits using the same equations that too for both **abc** and **acb** sequence. We create four different code segments to solve four combinations i.e. WYE-WYE, WYE-DELTA, DELTA-WYE, DELTA-DELTA. Mesh equations are represented using two matrices – one representing coefficient matrix and the other constant matrix. Mesh equations are solved using **Gauss Jordan elimination** and in this way mesh currents are calculated. Using mesh currents- line currents, phase currents, line voltages, phase voltages, total power, real power, reactive power, power factor at the load's end are calculated. And then these results are shown in the output window.

Mesh equations for four combinations are given below:

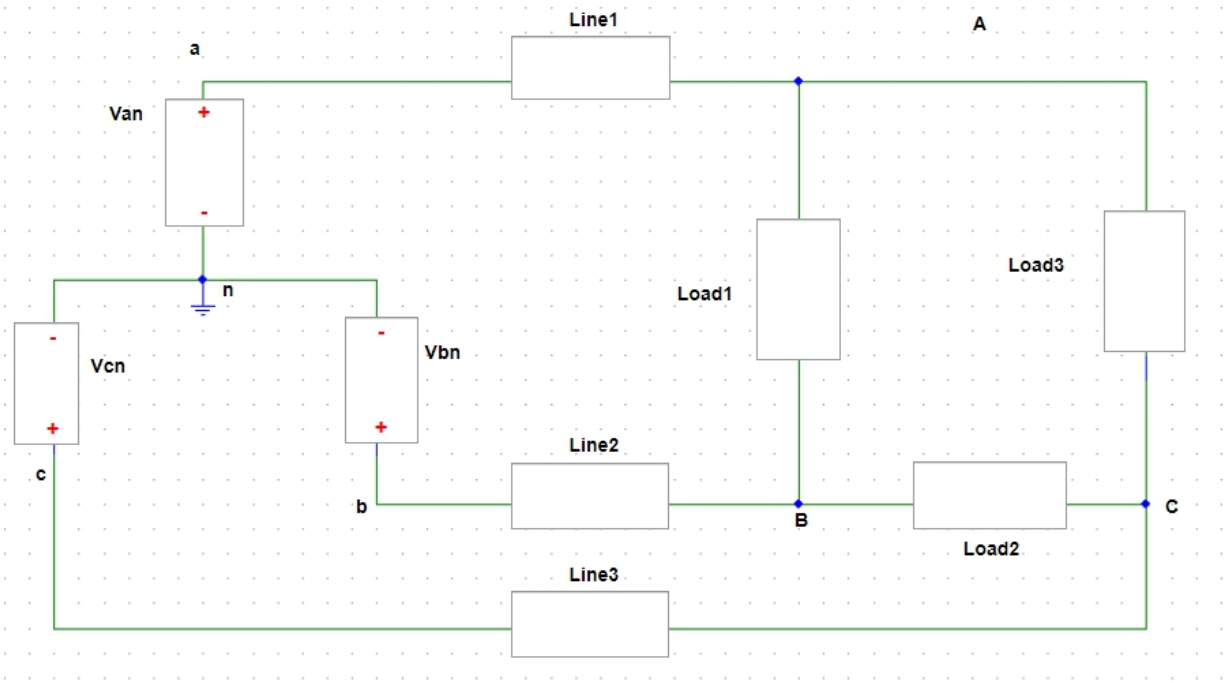
WYE-WYE:



Coefficient Matrix = [Line1+Line2+Load1+Load2 -Line2-Load2; -Line2-Load2 Line2+Load2+Line3+Load3];

Constant Matrix = [Van-Vbn; Vbn-Vcn];

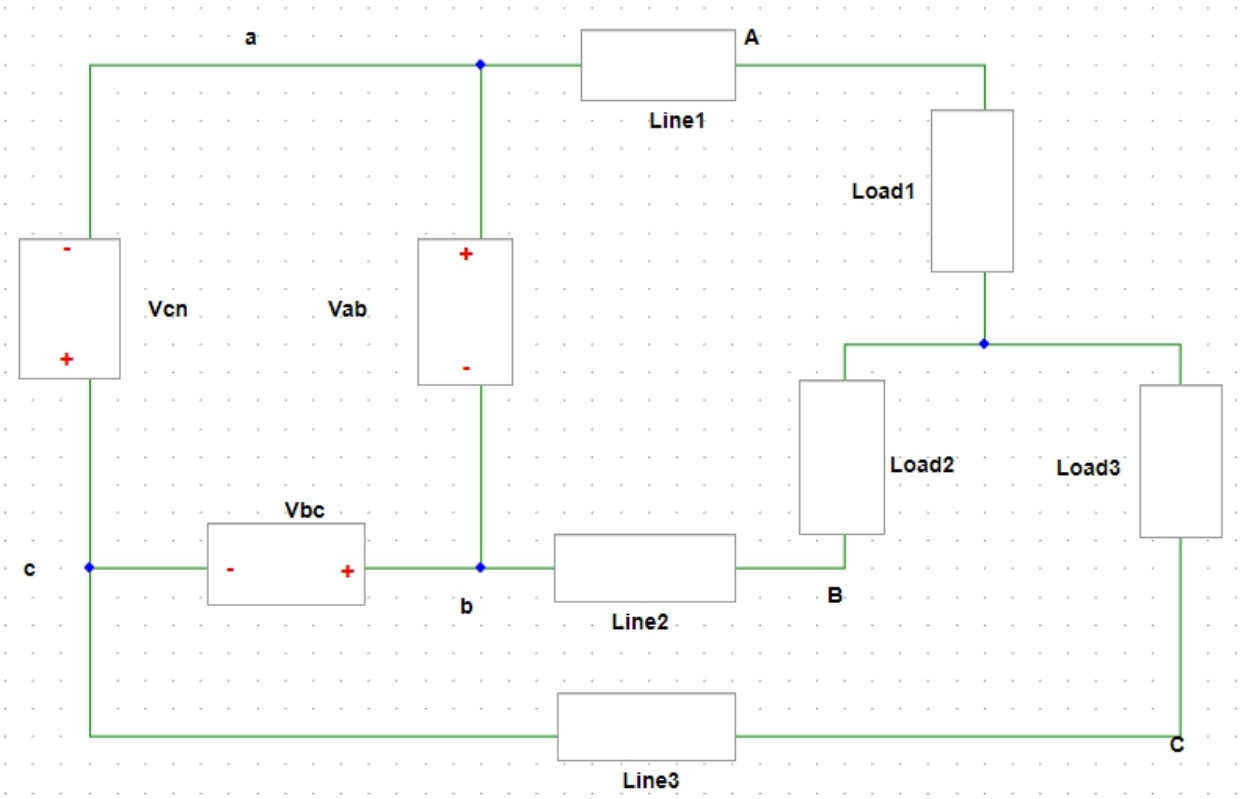
WYE-DELTA:



Coefficient Matrix: [Line1+Load1+Line2 -Load1 -Line2;-Load1 Load1+Load2+Load3 -Load2;-Line2 -Load2 Load2+Line2+Line3];

Constant Matrix: [Van- Vbn;0; Vbn- Vcn];

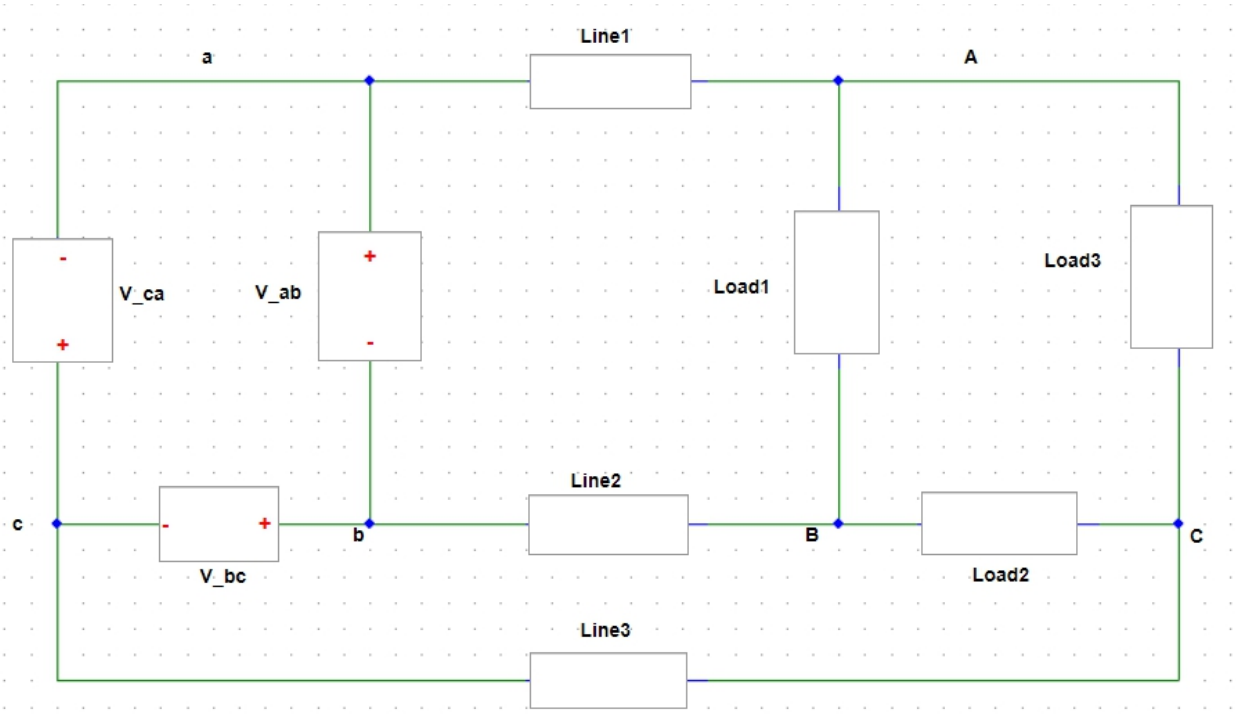
DELTA-WYE:



Coefficient Matrix = [Line1+Line2+Load1+Load2 -Line2-Load2;-Line2-Load2 Load2+Load3+Line3+Line2];

Constant Matrix = [Vab;Vbc];

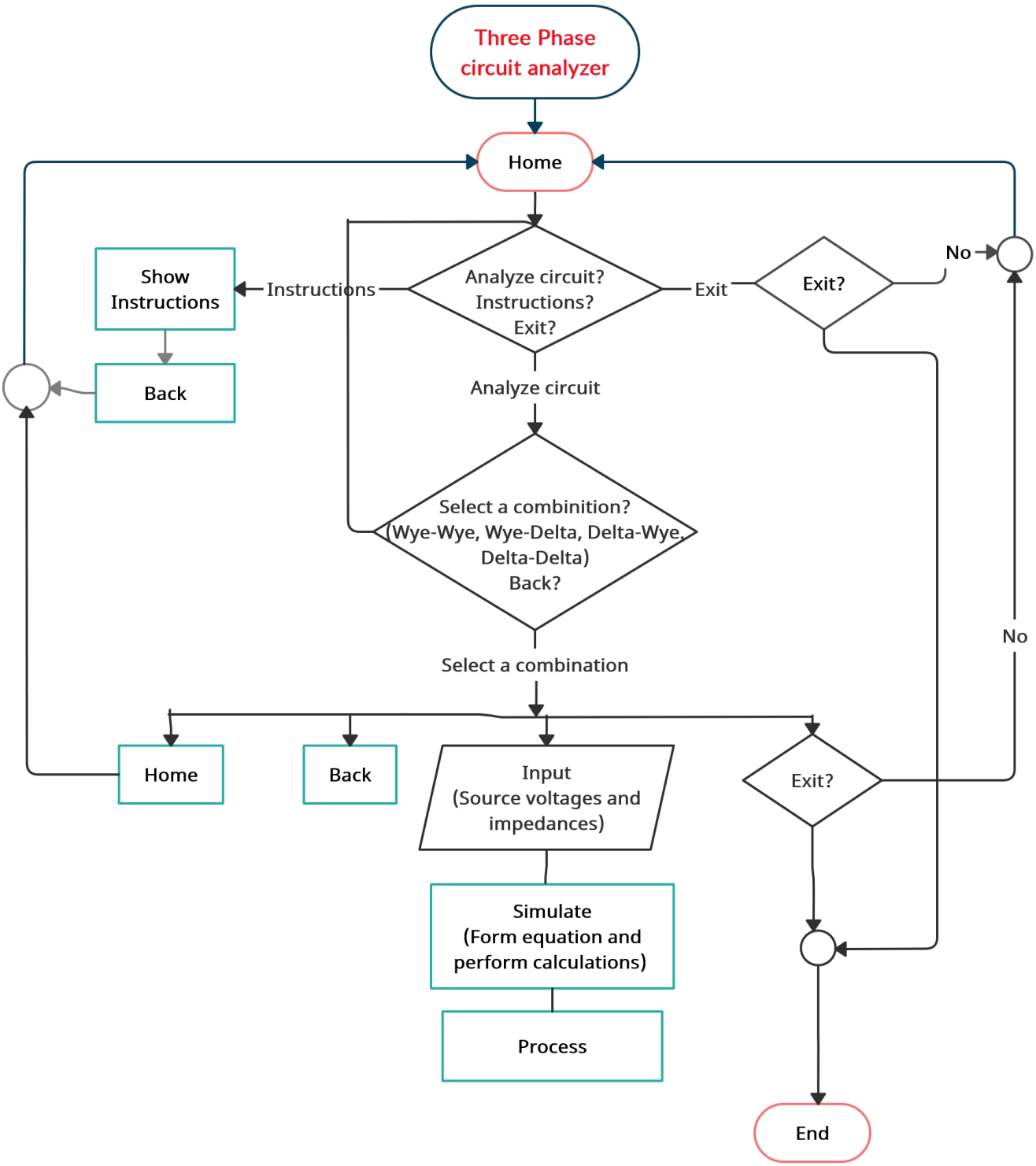
DELTA-DELTA:



Coefficient Matrix = [Line1+Load1+Line2 -Line2 -Load1; -Line2 Line3+Line2+Load2 -Load2; -Load1 -Load2 Load1+Load3+Load2];

Constant Matrix = [Vab;Vbc;0];

Flow chart:


Three Phase circuit analyzer
Home
Analyze circuit? Instructions? Exit?
Instructions
Show Instructions
Back
Exit
Exit?
No
Analyze circuit
Select a combinition? (Wye-Wye, Wye-Delta, Delta-Wye, Delta-Delta) Back?
Select a combination
Home
Back
Input (Source voltages and impedances)
Exit?
No
Simulate (Form equation and perform calculations)
Process
End

Three Phase Circuit Analyzer

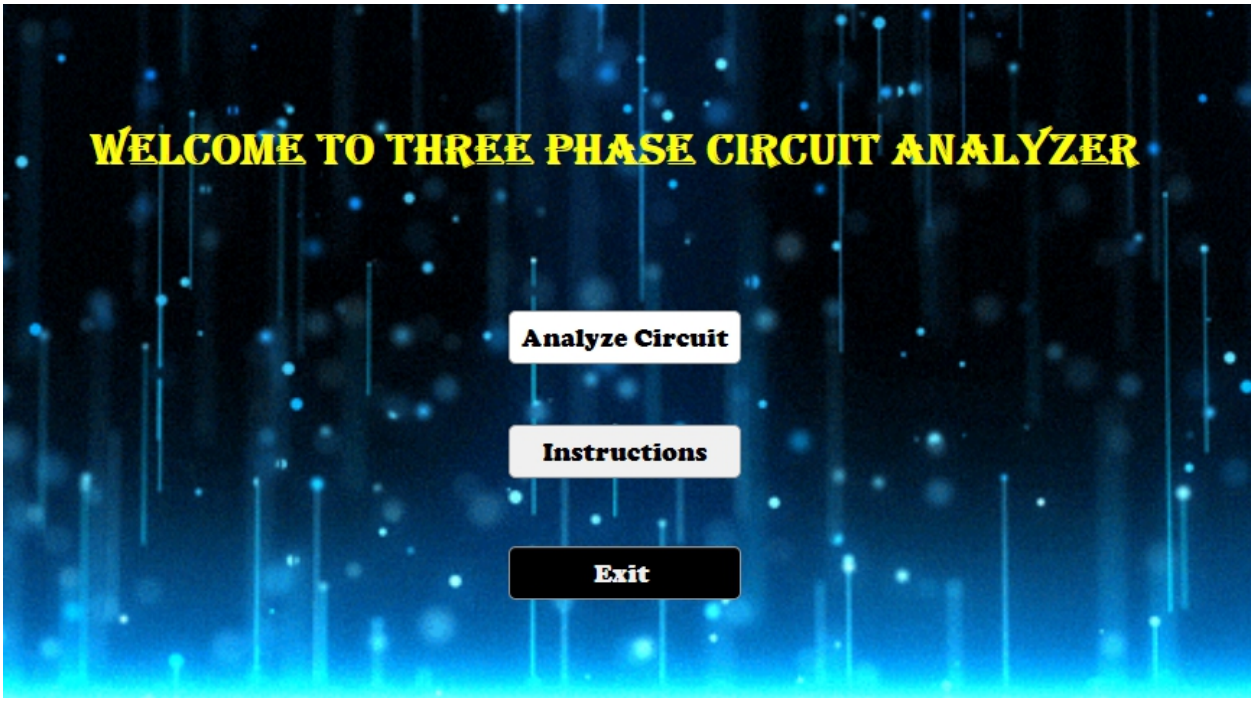
We have created a graphical user interface for running this program successfully. In this part of the project, we used GUI for creating a graphical user interface.

Starting the app:

This program starts with this window. To initiate the program, one has to run Three_phase_analyzer.mlapp

By clicking on the button *Click here to continue*, user enters the homepage. This window basically serves no special purpose. It simply initiates the app's execution.

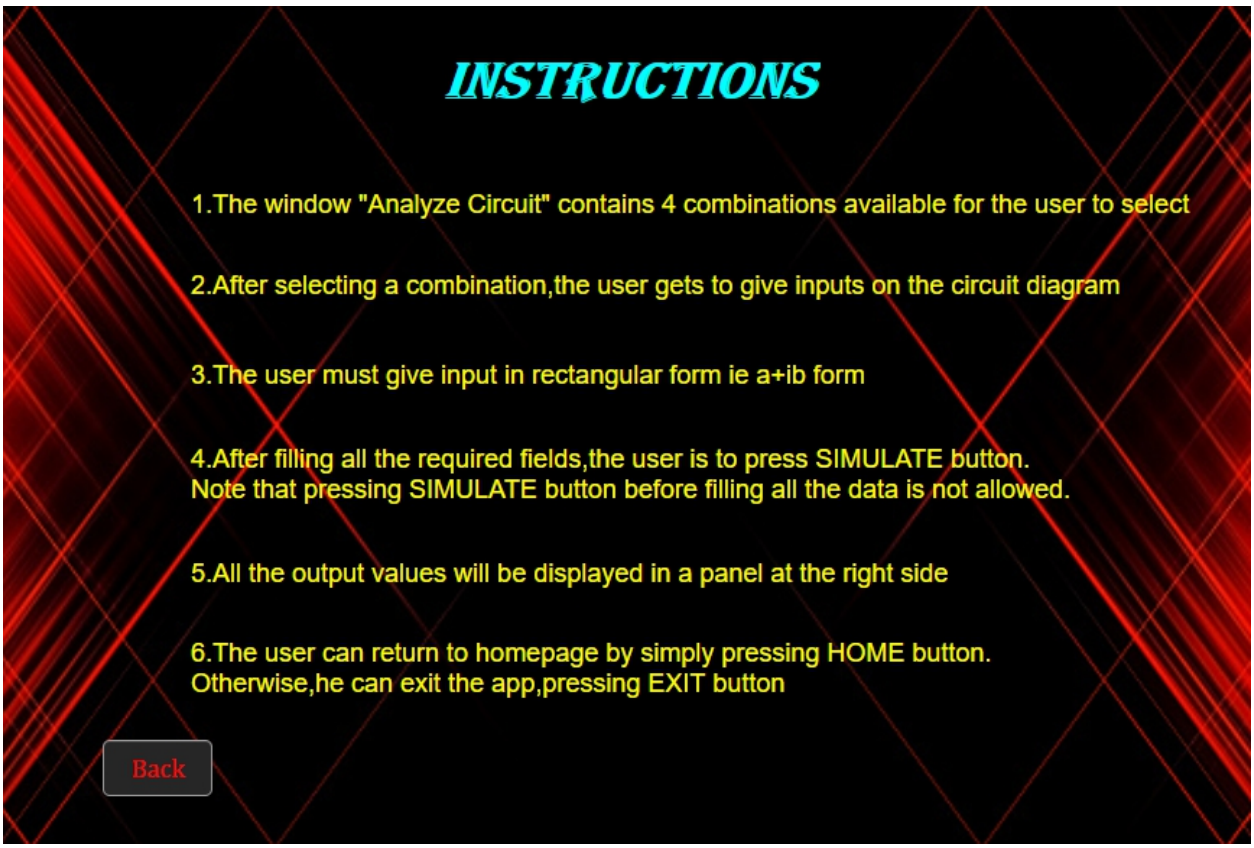
Homepage:



Homepage welcomes the user. Here the user has to choose between *Analyze circuit, Instructions* and *Exit*. By selecting *Exit* one can close the program. By selecting *Instructions* one can read how to operate the *Three Phase Circuit Analyzer*. The main portion of this project starts with selecting *Analyze Circuit*.

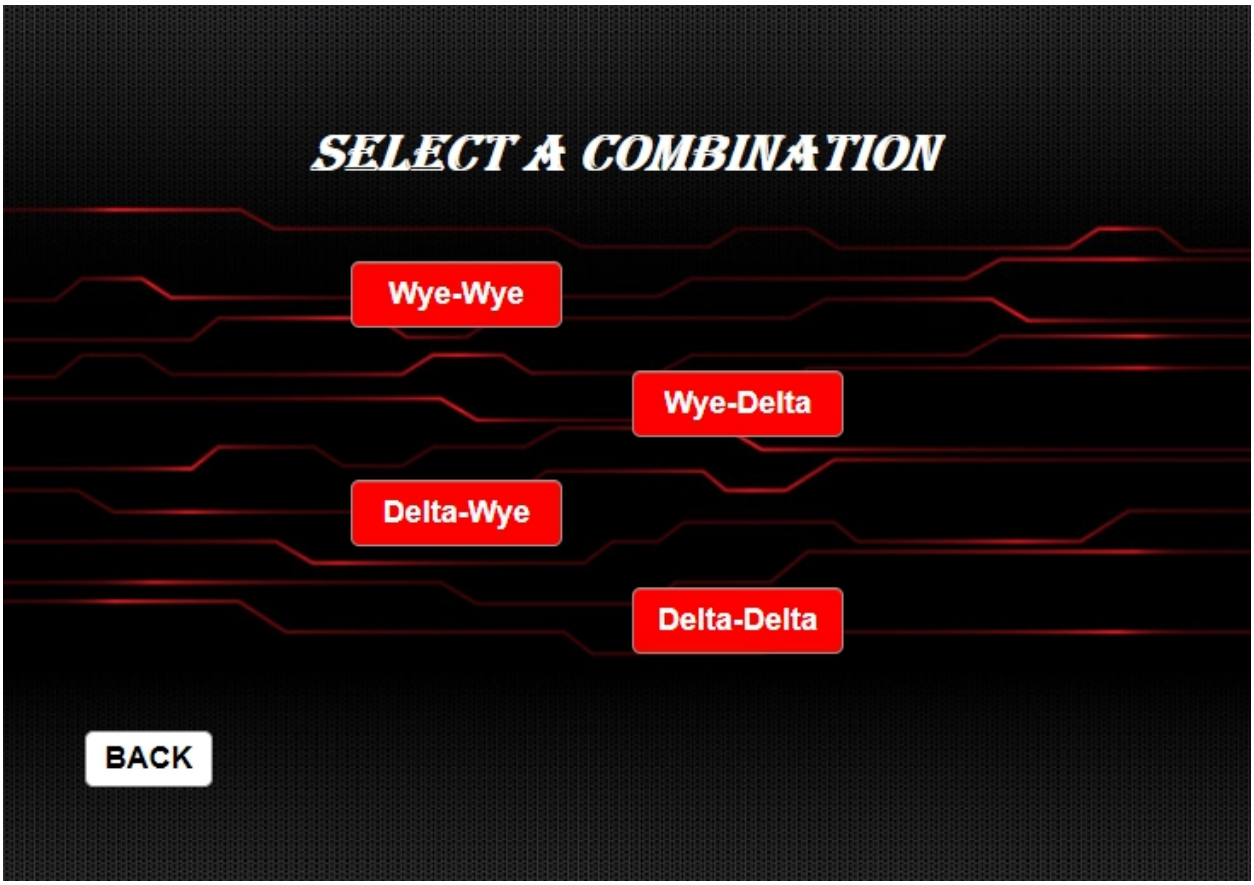
Instructions:

This window provides basic instructions about how to use this app to successfully analyze circuits. After reading the instructions, the user can go back to the homepage by clicking the Back button.



Analyzing the Circuit:

The main function of this app starts with this window. Here the user has to choose between the four combinations namely Wye-Wye, Wye-Delta, Delta-Wye, Delta-Delta. User can go back to the homepage by clicking the BACK button.



The Four Combinations:

This is the main window of this app. This window consists of a circuit diagram, the output panel, and the buttons HOME, BACK, SIMULATE, EXIT.

The basic structures of these four windows are basically the same. The only difference between them is the circuit diagram. Of course, there are differences in the code sections as well.

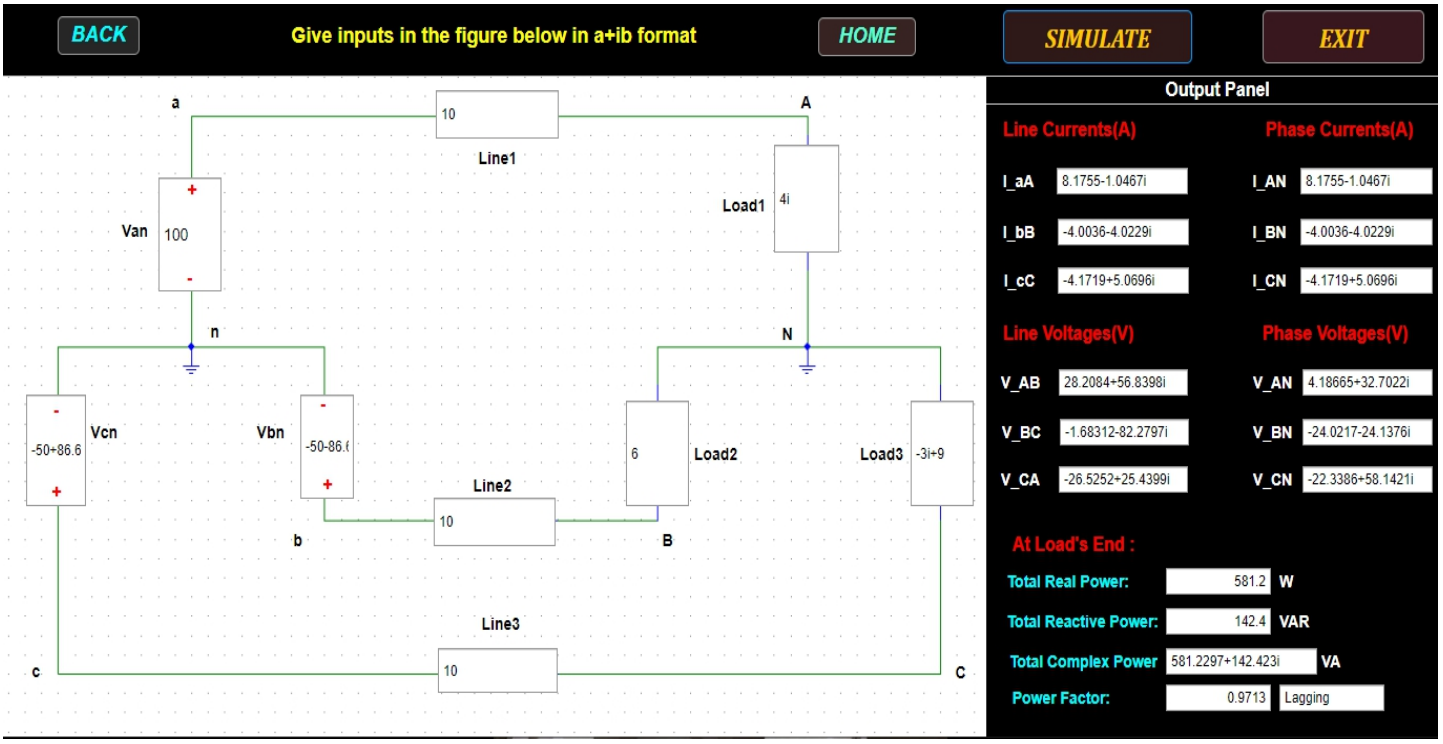


Fig:**Wye-Wye**

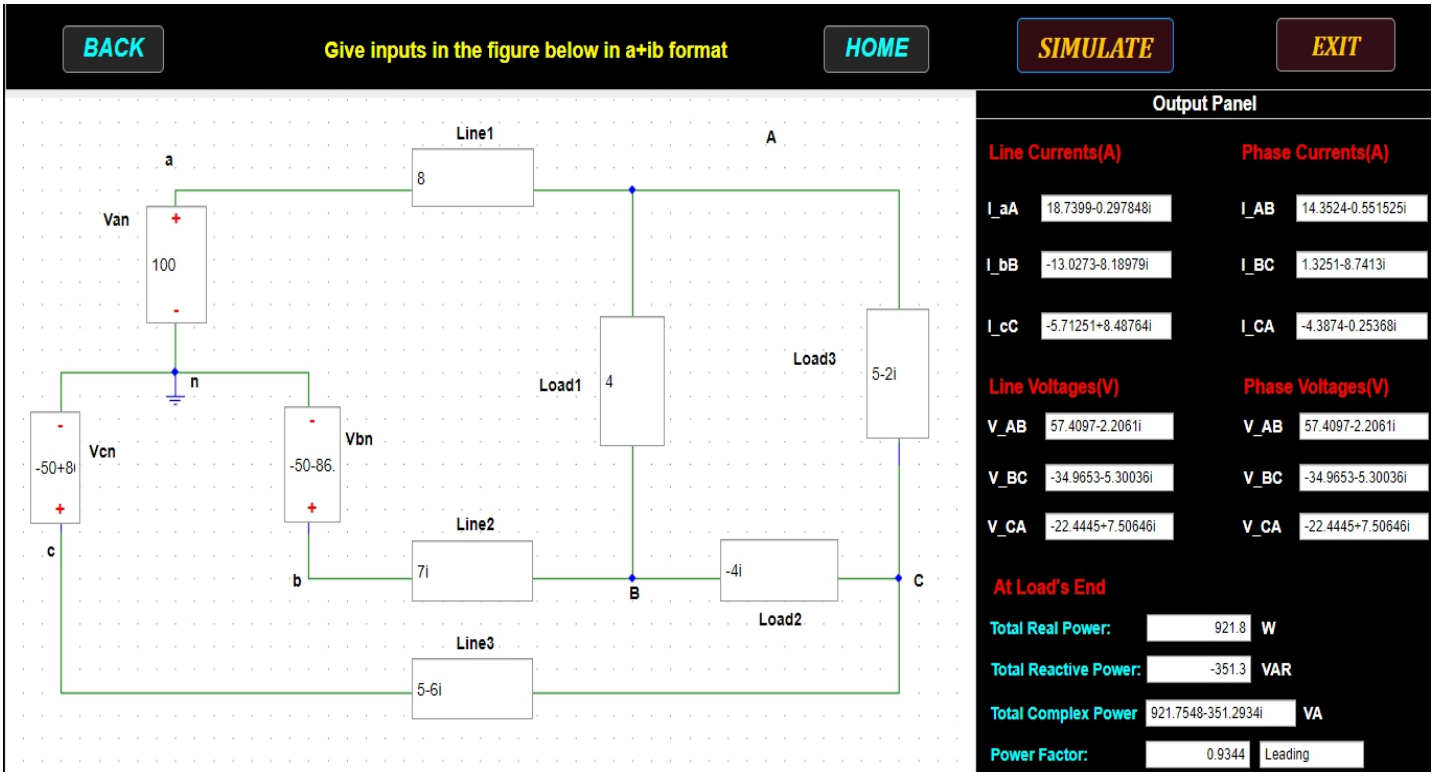


Fig:**Wye-Delta**

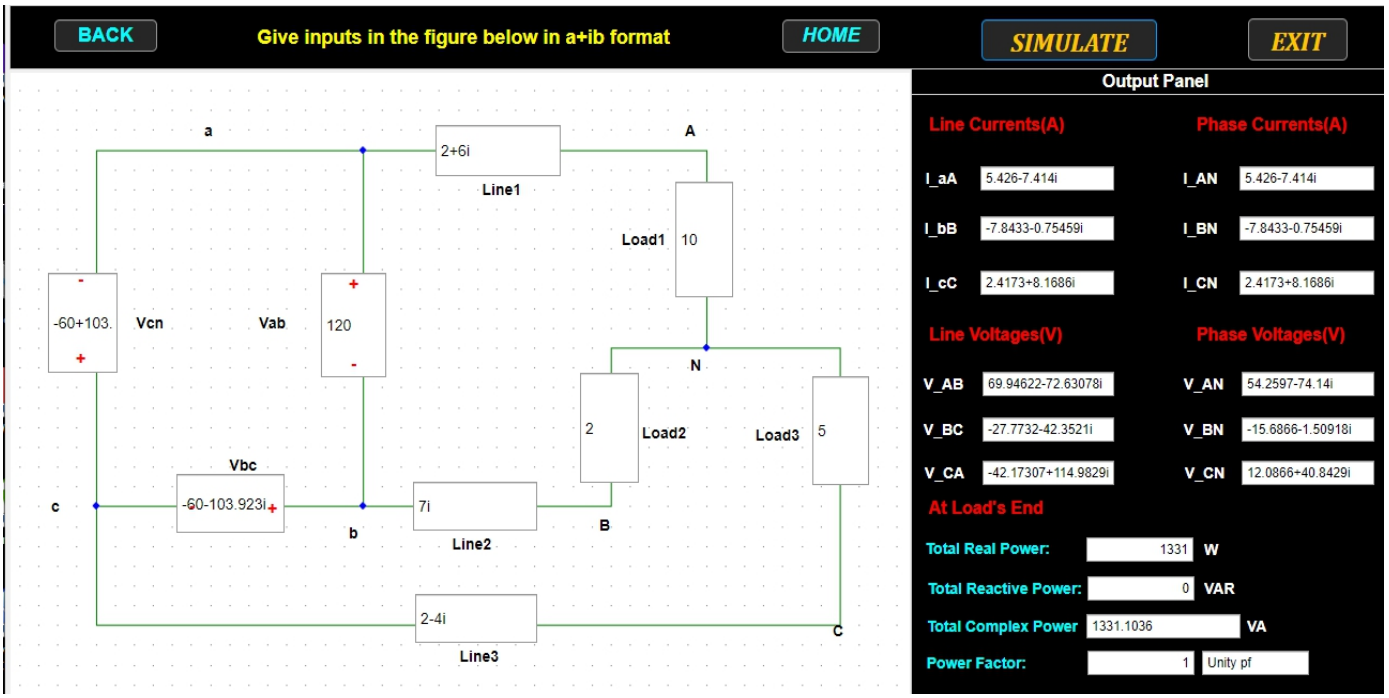


Fig:**Delta-Wye**

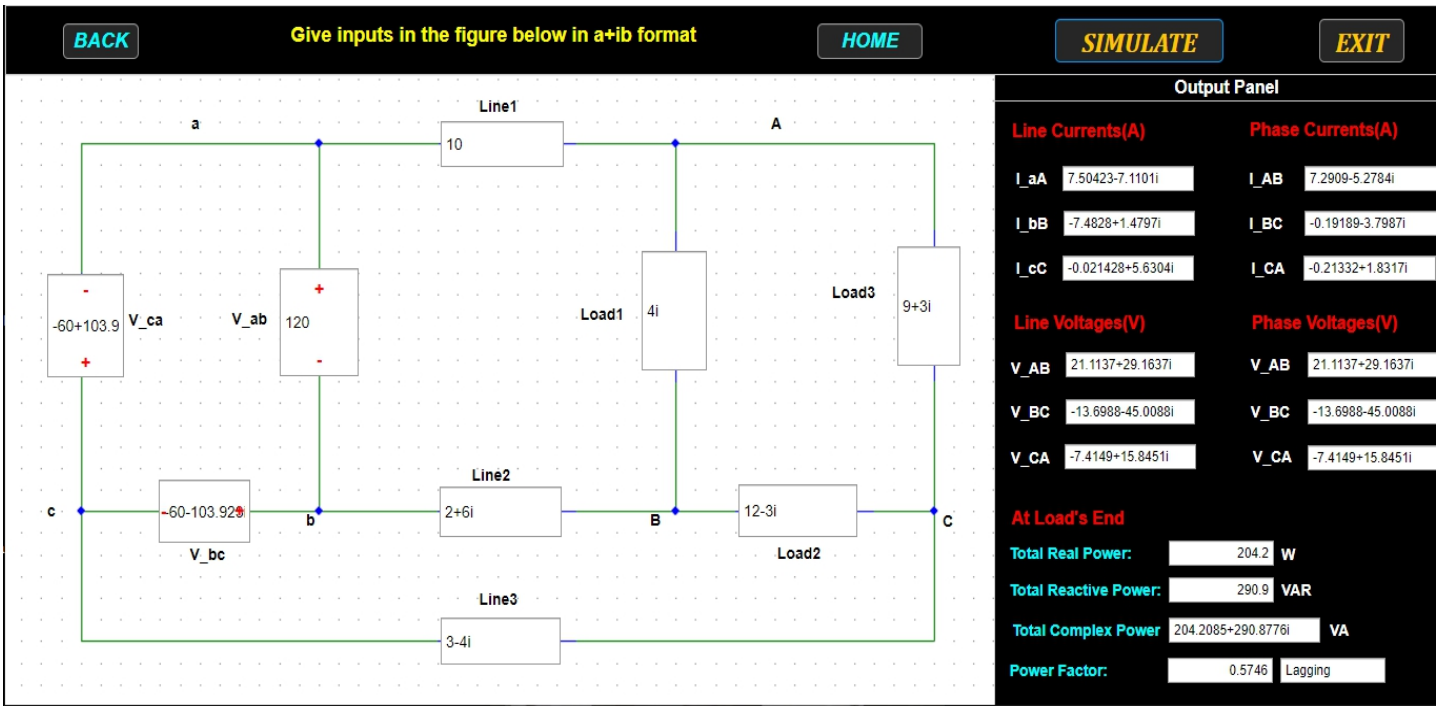


Fig:**Delta-Delta**

Input Panel:

The circuit diagram itself is the **input panel**. The user is supposed to enter the value of the voltage of voltage source, line impedances, load impedances. The inputs must be entered in a+ib format.

Output Panel:

After entering the inputs, the user has to click the **SIMULATE** button. After clicking this, the circuit is analyzed and outputs appear in the **output panel** at the right side. It gives Line currents, Line voltages, Phase currents, Phase voltages.

Also gives real power, reactive power, total complex power and power factor at load's end.

There is also **BACK**, **HOME**, **EXIT** button. The BACK button takes the user back to the window of selecting combinations. HOME takes to the homepage and EXIT is to close the app.

Result Analysis:

From the above 4 combinations, we have obtained results that match with our theoretical knowledge with utmost accuracy. In Wye-Wye & Delta-Wye , both line and phase currents are the same whereas in Delta-Delta and Wye-Delta, the phase and line voltages are the same.

Not only that, when capacitive loads were used in Wye-Delta configuration, we have obtained **Leading pf** and when only resistive loads were used in Delta-Wye,we have obtained **Unity pf** which also satisfies our theoretical knowledge. In Wye-Wye, the pf is **Lagging** since the inductive load used is dominant here.

EXIT page:

By clicking EXIT, the user goes to the exit window. Here, he has to confirm whether he really wants to exit or not. By clicking YES, the app closes. But if NO is clicked the user goes back to the homepage.

Conclusion:

While establishing this app we have tried our best to make sure this app works for all types of balanced and unbalanced three phase circuits. We used GUI to make this app user friendly. We created a window named Instructions for this purpose. We hope this app would work just fine and help students in analyzing three phase circuits.