Realization of AC Bridges Using LabView.

Introduction:

AC Bridges are used to measure the values of unknown resistance, inductance, and capacitance. Although, AC bridges are believed to be very convenient and provides accurate result of the measurement. The construction of the bridges is very simple. The bridge has four arms, one AC supply source and the balance detector. It works on the principle that the balance ratio of the impedances will give the balance condition to the circuit which is determined by the null detector. The bridges have four arms, two have non-inductive resistance and the other two have inductances with negligible resistance.

Software Used: LabView

LabVIEW is essentially a graphical programming language (technically it's a development environment, and the language is "G", but in common usage it's a language). Instead of typing words like with C++,Python, or other text-based languages, you place and connect visual objects around your screen. Using LABVIEW the AC bridges can be Solved at an ease with proper visualization and insights. The graphical programming approach enables us to build or Solve AC bridges for different number of applications such as measuring the frequency of the audio signals, filtration of undesirable signals etc.

Details:

AC Bridges that have been analyzed using LabView are:

(1) Maxwell's Inductance Bridge.

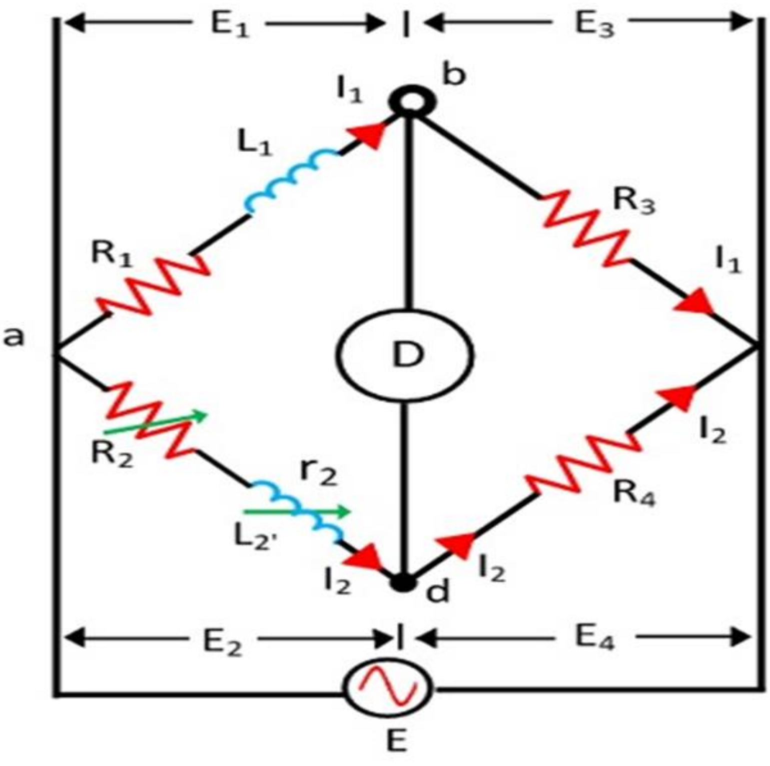
(2) DeSauty's Capacitance Bridge.

(3) Wheatstone's Resistance Bridge.

Explanation:

Maxwell's Inductance Bridge:

A Maxwell bridge is a modification to a Wheatstone bridge used to measure an unknown inductance in terms of calibrated resistance and inductance or resistance and capacitance.



Maxwell's Inductance Bridge

Let us consider w=314,

Let us consider E to be a constant (let it be 100V).

When the circuit is balanced then, current passing through the galvanometer(D)= 0.

If the circuit is balanced, then from the circuit the line “abc” is parallel to line “adc”.

<u>By Voltage division rule:</u>

Voltage across “ab” i.e.,

Vab= (E(R1+XL1))/(R1+R3+XL1).*

Vab= E(Sqrt(R1*R1+wL1*wL1))/Sqrt((R1+R3)*(R1+R3)+wL1*wL1)*

Vb=E-Vab;

Voltage across "ad" i.e., $Vad=(E*Sqrt((R2+r2)*(R2+r2)+wL2*wL2))/Sqrt((r2+R2+R4)*(r2+R2+R4)+wL2*wL2)$

$Vd=V-Vad$;

Since the circuit is balanced,

"$Vb-Vd=0$"

If for the value of L1 and R1 given for the circuit doesn't satisfy $Vb-Vd=0$, then the circuit is not balanced.

Theoretical Values of L1 And R1:

At balanced condition:

$L1= (R3*L1)/R4;$

$R1= (R3*(R2+r2))/R4$

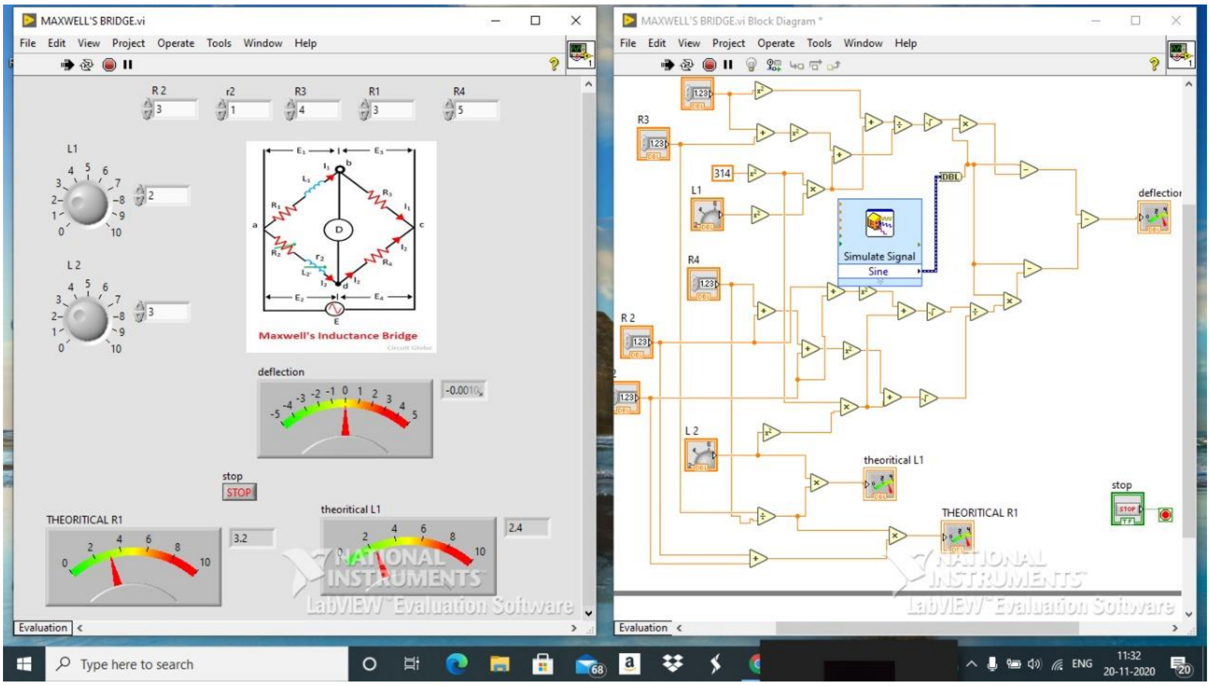
Procedure:

1. For the supply, we have considered, a sine wave input, we get this from input function of the LabView software. We considered frequency of the input to be 50Hz.
2. We have considered the 5 numeric controls for the resistors, 2 numeric knobs for the inductors, and numeric constant for angular frequency from the numeric functions of the LabView.
3. Indicate above meters according to its equivalent names from given circuit diagram.

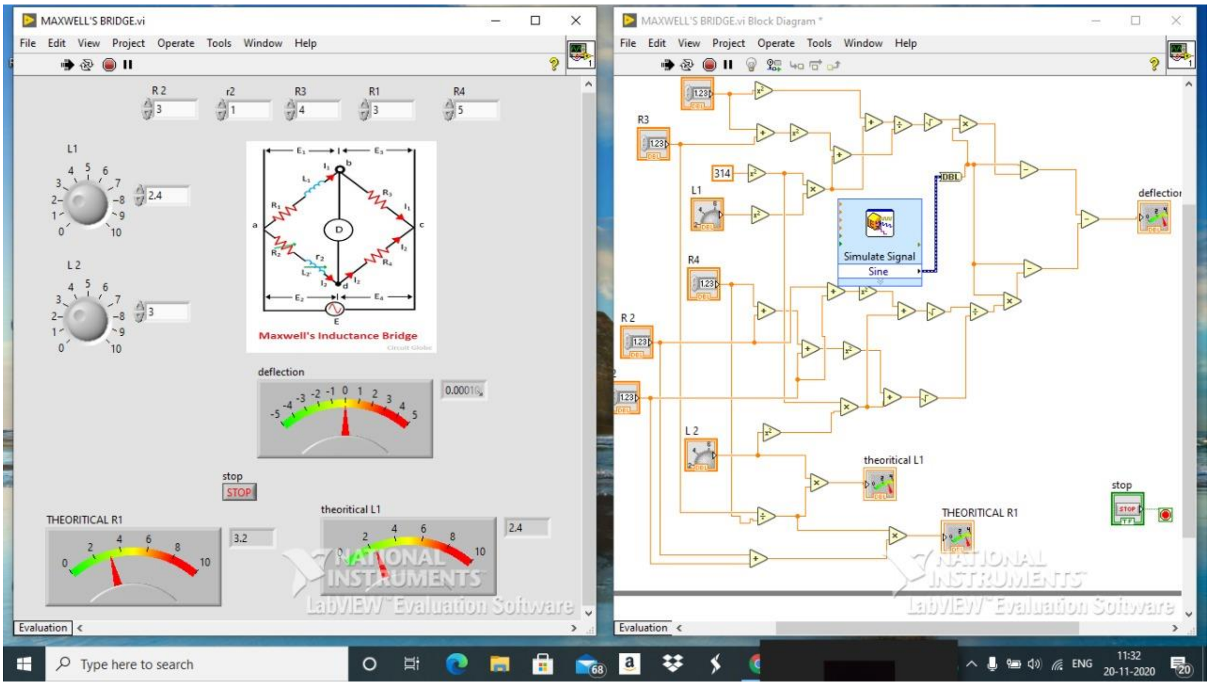
4. Now, by using numeric controls such as addition, subtraction, etc, to form the equations "$Vab= E*(Sqrt(R1*R1+wL1*wL1))/Sqrt((R1+R3)*(R1+R3)+wL1*wL1)$"and then make a equation "$Vb=E-Vab$"
5. Now, similar to the above point, form a equation "$Vad=(E*Sqrt((R2+r2)*(R2+r2)+wL2*wL2))/Sqrt((r2+R2+R4)*(r2+R2+R4)+wL2*wL2)$"and then form a equation "$Vd=E-Vad$"
6. Now, using subtraction numeric control, subtract "$Vb-Vd$"and give this connection to numeric meter and name it as deflection.

7. If the deflection value is zero then, for the given values of the resistors and inductors the bridge is balanced. Or else we would be getting deflection either positive or negative depending on given values of inductors and resistors in it.
8. We, even form an equation *“L1= (R3*L2)/R4”* using the numeric control functions.
9. The above equation is the condition in which the circuit gets balanced and deflection will be zero for the above values of resistors and inductors.

MAXWELL’S BRIDGE BEFORE BALANCING:

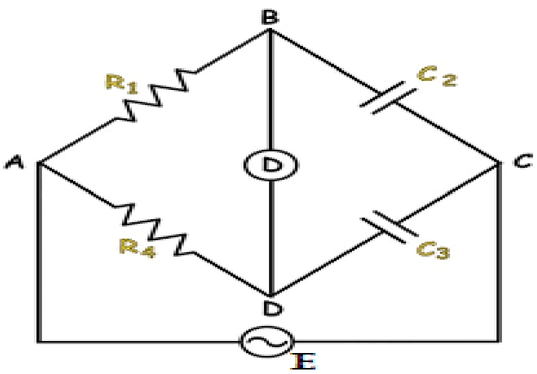


MAXWELL’S BRIDGE AFTER BALANCING:



DESAUTY’S CAPACITANCE BRIDGE:

De Sauty Bridge measures an unknown capacitance in term of a standard capacitance i.e. comparing two capacitance's Two ratio arm of this bridge consist pure resistor and two consist capacitor where one is of known value and another is standard capacitor. Balance is obtained by varying either R_1 or R_4.



Let us consider *w=314*,

Let us consider E to be a constant (let it be 100V).

When the circuit is balanced then, current passing through the galvanometer(D)= 0.

If the circuit is balanced, then from the circuit the line "abc" is parallel to line "adc".

By Voltage division rule:

Voltage across "AB" i.e.,

$Vab=(E*R1)/(R1+XC2)$

$Vab=(E*R1)/Sqrt((R1)*(R1)+1/((wC2)*(wC2)))$

$Vb=E-Vab$;

Voltage across "AD" i.e., $Vad=(E*R4)/(R4+XC3)$

$Vad=(E*R4)/Sqrt((R4)*(R4)+(1/(wC3)*(wC3)))$

$Vd=E-Vad$

Since the circuit is balanced,

"$Vb-Vd= 0$"

If for the value of C2 given for the circuit doesn't satisfy "$Vb-Vd=0$", then the circuit isn't balanced.

<u>TheoreticalValueOfC2</u> :

At balanced condition:

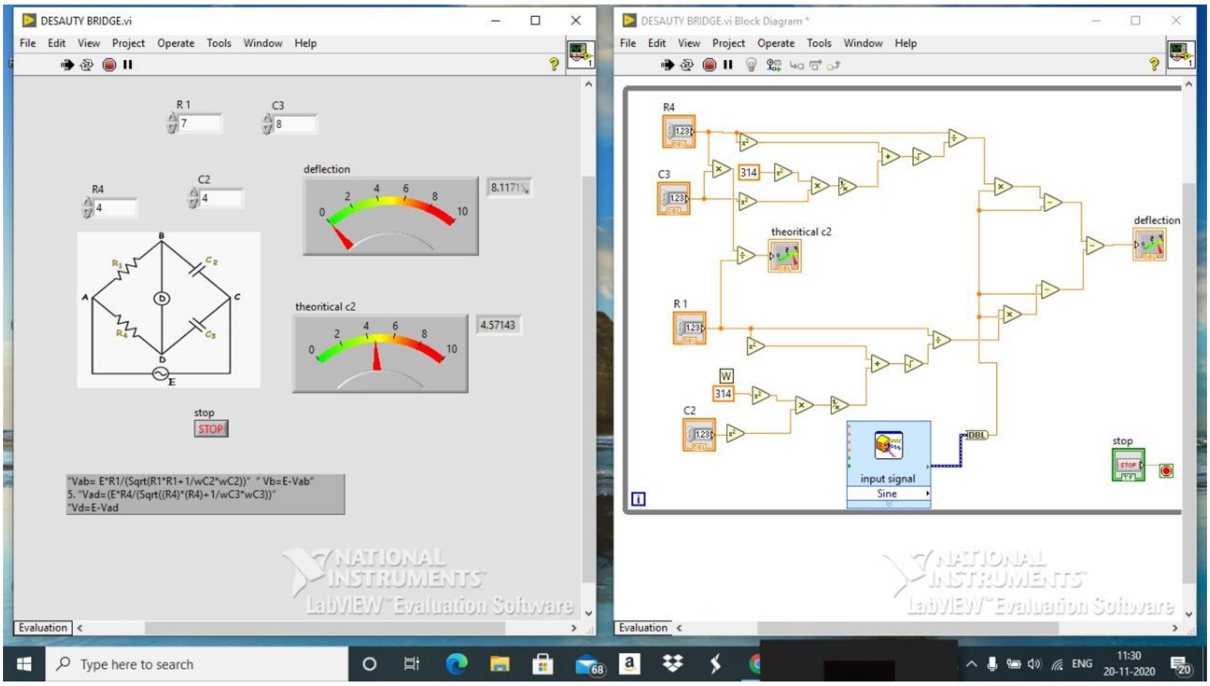
$C2= C3*R4/R1$

Procedure:

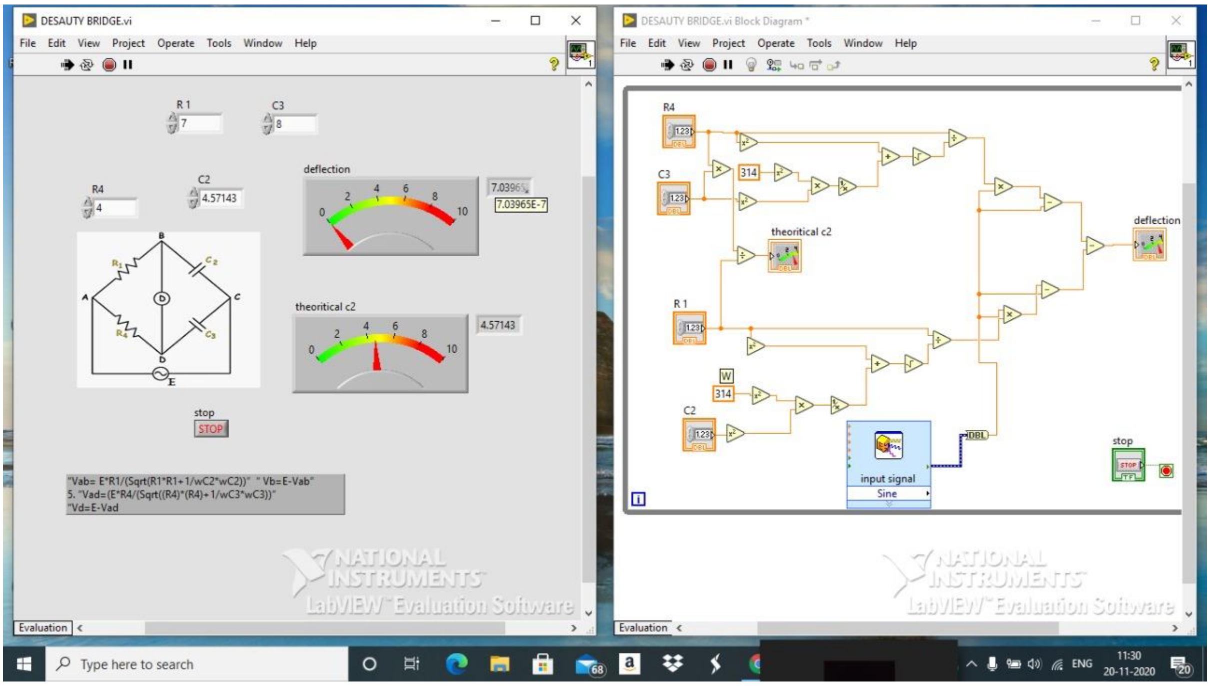
1. For the supply, we have considered, a sine wave input, we get this from input function of the LabView software. We considered frequency of the input to be 50Hz.
2. We have considered the 4 numeric controls for the resistors and capacitors, and numeric constant for angular frequency from the numeric functions of the LabView.

3. Indicate above meters according to its equivalent names from given circuit diagram.
4. Now, by using numeric controls such as addition, subtraction, etc, to form the equations *"Vab= E*R1/(Sqrt(R1*R1+wC2*wC2))"*and then make a equation *" Vb=E-Vab"*
5. Now, similar to the above point, form a equation *"Vad=(E*R4/(Sqrt((R4)*(R4)+wC3*wC3))"*and then form a equation *"Vd=E-Vad"*
6. Now, using subtraction numeric control, subtract *"Vb-Vd"*and give this connection to numeric meter and name it as deflection.
7. If the deflection value is zero then, for the given values of the resistors and capacitors the bridge is balanced. Or else we would be getting deflection either positive or negative depending on given values of capacitors and resistors in it.
8. We, even form an equation *"C2= (R4*C3)/R1"* using the numeric control functions.
9. The above equation is the condition in which the circuit gets balanced and deflection will be zero for the above values of resistors and capacitors.

DESAUTY BRIDGE BEFORE BALANCING:

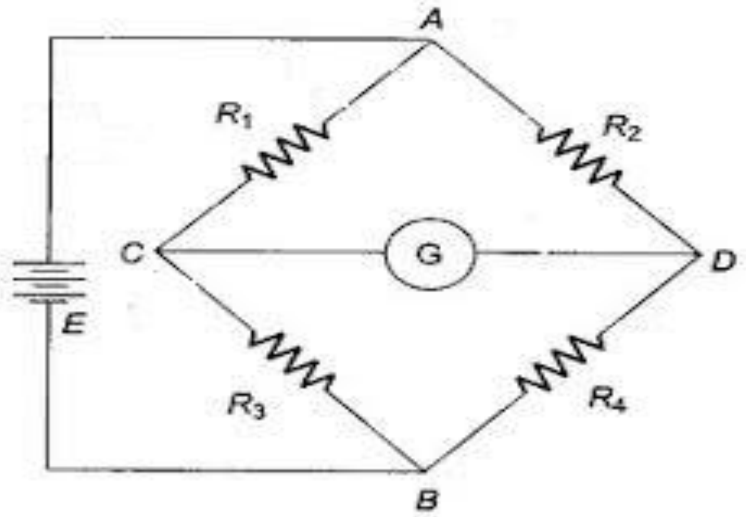


DESAUTY BRIDGE AFTER BALANCING:



WHEATSTONE’S RESISTANCE BRIDGE:

A Wheatstone bridge is an electrical circuit used to measure an unknown electrical resistance by balancing two legs of a bridge circuit, one leg of which includes the unknown component. The primary benefit of the circuit is its ability to provide extremely accurate measurements.



Let us consider *w=314,*

Let us consider E to be a constant (let it be 100V).

When the circuit is balanced then, current passing through the galvanometer(D)= 0.

If the circuit is balanced, then from the circuit the line "abc" is parallel to line "adc".

By Voltage division rule:

Voltage across "AC" i.e., *Vac=(E*R1)/(R1+R3)*

Vc=E-Vac;

Voltage across "AD" i.e., *Vad=(E*R2)/(R2+R4)*

Vd=E-Vad;

Since the circuit is balanced,

"Vc-Vd=0"

If for the value of R1 given for the circuit doesn't satisfy *"Vc-Vd =0",* then the circuit isn't balanced.

Theoretical Value of R1:

At balanced condition:

*R1=R2*R3/R4*

Procedure:

1. For the supply, we have considered, a numeric constant input, we get this from input function of the LabView software.

2.We have considered the 4 numeric controls for the resistors and capacitors, and numeric constant for angular frequency from the numeric functions of the LabView.

3.Indicate above meters according to its equivalent names from given circuit diagram.

4.Now, by using numeric controls such as addition, subtraction, etc, to form the equations *"Vab= E*R1/(R1+R3)"* and then make a equation *" Vb=E-Vab"*

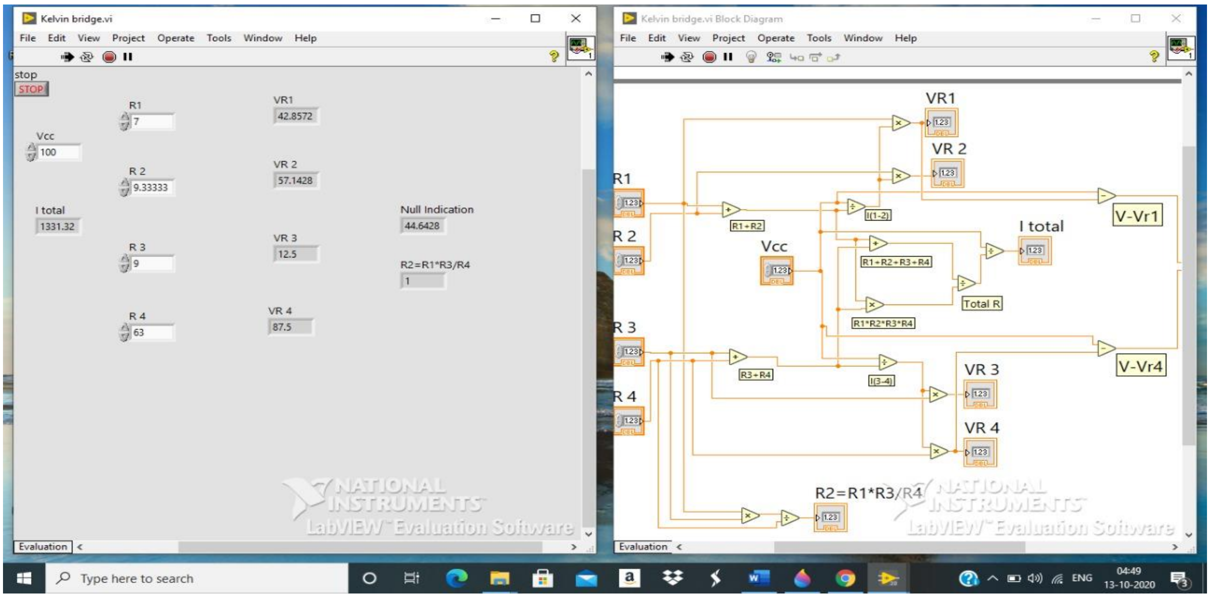
5.Now, similar to the above point, form a equation *"Vad=(E*R2/(R2+R4)"* and then form a equation *"Vd=E-Vad"*

6. Now, using subtraction numeric control, subtract *"Vb-Vd"* and give this connection to numeric meter and name it as deflection.

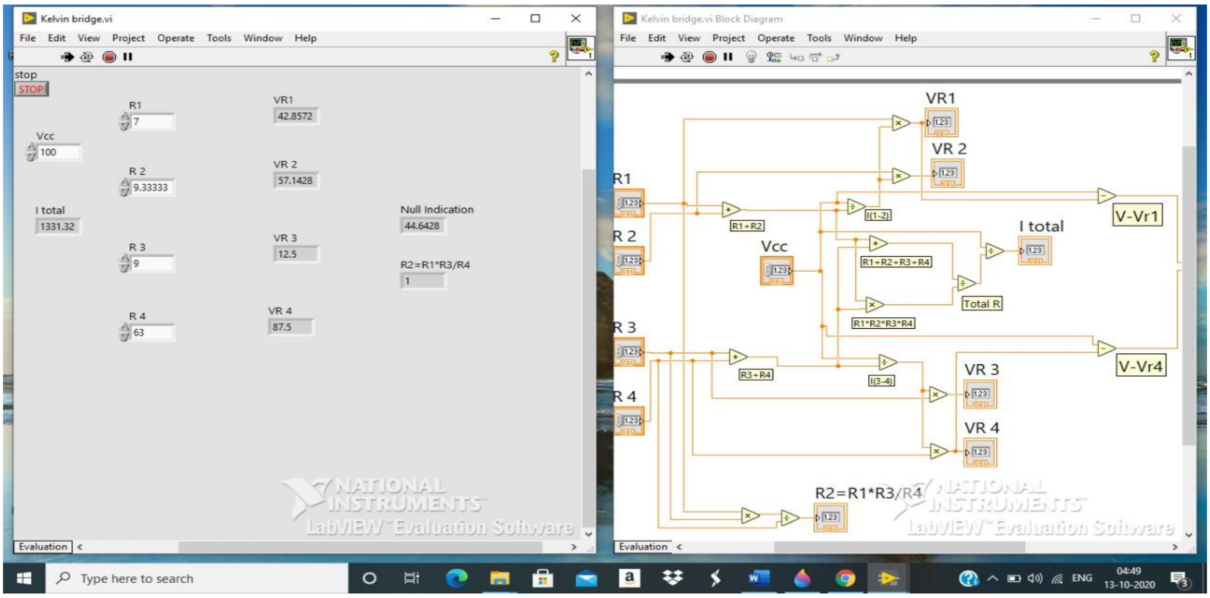
7.If the deflection value is zero then, for the given values of the resistors and capacitors the bridge is balanced. Or else we would be getting deflection either positive or negative depending on given values of resistors in it.

8. We, even form an equation *"R1= (R2*R3)/R4"* using the numeric control functions.
9. The above equation is the condition in which the circuit gets balanced and deflection will be zero for the above values of resistors.

WHEATSTONE BRIDGE BEFORE BALANCING



WHEATSTONE BRIDGE AFTER BALANCING:



Result:

The values of deflection are determined such that the bridges are balanced. Also using the values of capacitances, inductances and resistances the concept of null-deflection is proved and verified. LabView software enables the application and usage of bridges via laptop through Data Aquisition System (DAQ).

Conclusion:

Thus, using LabView software we were able to resolve the complex AC Bridges and balance them accordingly. LabView has made it easier to determine the unknown values of resistance, capacitance and inductance. Also, if LabView is used on bigger platforms, it can bring many changes and developments in various technical aspects.

For any quarries, Kindly Contact

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