Department of Electrical & Computer Engineering

LAB REPORT

Course Code : EEE141L

Course Title: Electrical Circuit Lab

Course Instructor: Faculty Name Abu Obaidah (AbO)

Experiment Number: 04

Experiment Name:

Delta-Wye Conversion.

Experiment Date: 4.7.2018

Date of Submission: 11.7.2018

Section: 08

Group Number: 07

Experiment Name:

Delta-Wye conversion.

Objective:

- To perform Delta-wye conversion.
- To verify the results with measured data.
- Solving a complex circuit using delta-wye conversion.

Theory:

Delta-wye connection:

Sometimes when we simplify a resistor network, we got stuck. Some resistor network can not be simplified using series and parallel combinations.

So, we have to use Delta-wye conversion.

which is an Technique for certain resistor combinations, that we can not be handled by the series and parallel combinations. This situation can often be handled by trying Δ-Y transformation.

The configarations can be referred to as a Π-T transformation.

Importance of Delta-Wye connection:

It is often useful to transform Δ-Y and Y-Δ while solving and electrical network. The transformation can make by trying Δ-Y transformation.

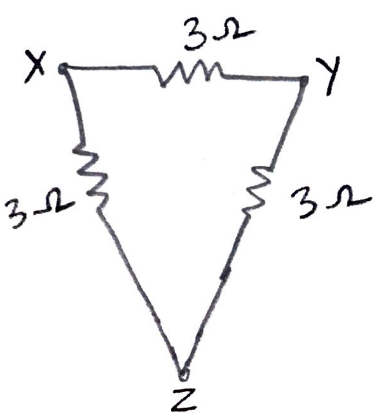
Conversion of Δ-Y [illegible] connection :

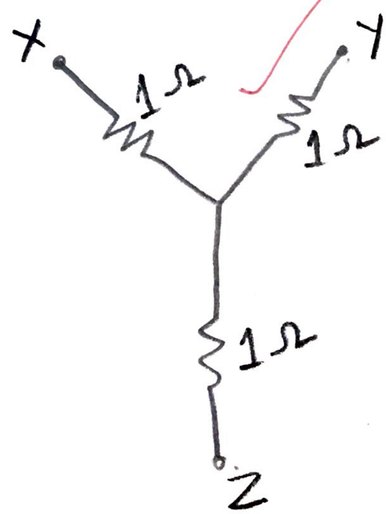
Assume that we have a Δ circuit with 3 Ω resistors. Derive the y equivalent by using Δ-Y equations.

$$R_1 = \frac{R_b R_c}{R_a + R_b + R_c} = \frac{3 \times 3}{3+3+3} = 1\ \Omega$$

$$R_2 = \frac{R_a R_c}{R_a + R_b + R_c} = \frac{3 \times 3}{3+3+3} = 1\ \Omega$$

$$R_3 = \frac{R_a R_b}{R_a + R_b + R_c} = \frac{3 \times 3}{3+3+3} = 1\ \Omega$$





Conversion of $Y \rightarrow \Delta$ connections:

$$R_a = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_1} = \frac{1 \cdot 1 + 1 \cdot 1 + 1 \cdot 1}{1} = 3\Omega$$

$$R_b = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_2} = \frac{1 \cdot 1 + 1 \cdot 1 + 1 \cdot 1}{1} = 3\Omega$$

$$R_c = \frac{R_1R_2 + R_2R_3 + R_3R_4}{R_3} = \frac{1 \cdot 1 + 1 \cdot 1 + 1 \cdot 1}{1} = 3\Omega$$

If all the resistors of the circuits are same, that means the Y and Δ networks are said to be balanced when

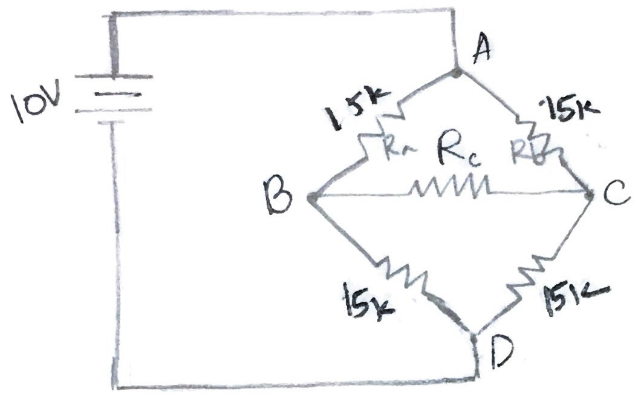
$$R_1 = R_2 = R_3 = R_Y;$$
$$R_a = R_b = R_c = R_\Delta;$$

Under this conversion formula become

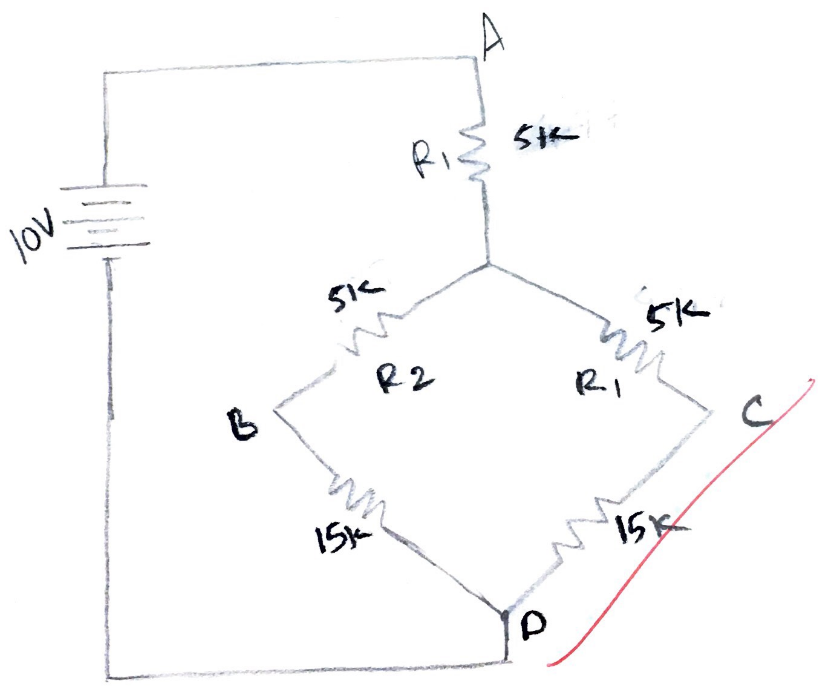
$$R_Y = \frac{R_\Delta}{3}$$

∴ parallel connection.

Circuit Diagram :



circuit - 1



circuit - 2

List of components:

1. Trainer Board.
2. Digital Multimeter (DMM)
3. 5 x 15 kΩ resistor
4. 3x5 kΩ resistor

Data collection:

Table 1

Theoretical R	Measured R	% Error
15k	14.58	2.8%
5k	4.77	4.6%

Table 2

Readings	Circuit 1	Circuit 2	% Error
V_{AD}	9.82	9.96	4%
V_{BD}	4.92	5.92	~~10%~~ 1%
V_{CD}	4.98	5.04	6%
V_{AB}	4.92	4.93	~~17%~~ 1%
V_{BC}	0.02	0.01	1%
V_{AC}	4.92	4.91	1%

Calculation:

Here we measured the resistors with DMM and write down in table 1 for circuit 1 and circuit-2. Then find out the error.

We know,

$$\% \text{ Error} = \frac{\text{Theoretical value} - \text{Practical value}}{\text{Theoritical value}} \times 100$$

$$= \frac{|15 - 14.58|}{15} \times 100\% = 2.8\%$$

again,

$$= \frac{|5 - 4.77|}{5} \times 100\% = 4.6\%$$

Then we measured the value of V_{AB}, V_{BD}, V_{CD}, V_{AB}, V_{BC}, V_{AC} in circuit 1 and 2. Then calculate the error.

Question and Answers:

- The resistors in circuit-1 are in a complex combination.

- I can use Delta-Wye conversion to find the equivalant resistance.

- In circuit-1

$Ra = 14.58$

$Rb = 14.58$

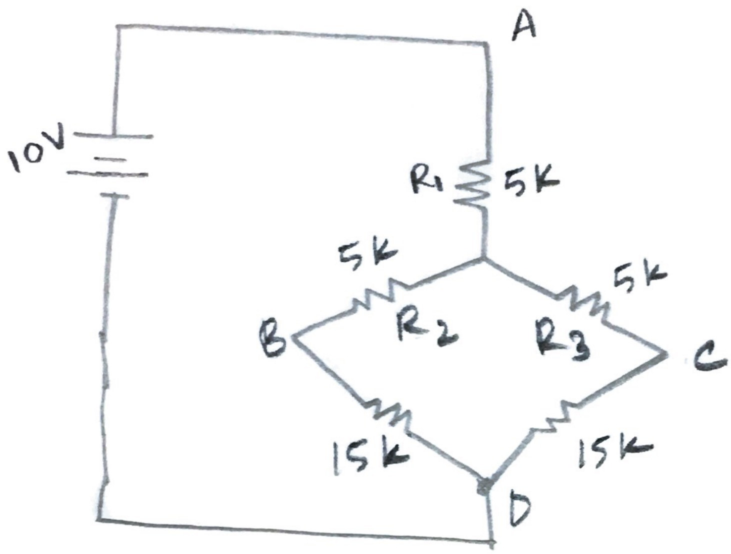
$Rc = 14.58$

$$\therefore R_1 = \frac{RbRc}{Ra+Rb+Rc} = \frac{14.58 \times 14.48}{14.58+14.58+14.58} = 4.86\Omega$$

$$\therefore R_2 = \frac{RaRc}{Ra+Rb+Rc} = \frac{14.58 \times 14.58}{14.58+14.58+14.58} = 4.86\Omega$$

$$\therefore R_3 = \frac{RaRb}{Ra+Rb+Rc} = \frac{14.58 \times 14.58}{14.58+14.58+14.58} = 4.86\Omega$$

Redrawing the equivalent circuit after applying the Delta-wye conversion for ΔABC



This is same as circuit 2.

Calculating Req:

here, $R_1 = 4.77\,\Omega$ $R_4 = 14.58\,\Omega$

$R_2 = 4.77\,\Omega$ $R_5 = 14.58\,\Omega$

$R_3 = 4.77\,\Omega$

So, let, $R_L = R_2 + R_4 = (4.77 + 14.58)$
$= 19.35$

$R_R = R_3 + R_5 = (4.77 + 14.58) = 19.35$

[As, R_2 and R_4 are in series
R_3 and R_4 are in series]

$$\therefore \frac{1}{R_G} = \frac{1}{R_L} + \frac{1}{R_R}$$

$$= \left(\frac{1}{19.35} + \frac{1}{19.35}\right) \Omega$$

$$\therefore R_G = 9.6 \Omega$$

Again, R_1 and R_G are in series combination.

$$\therefore R_{eq} = R_1 + R_p \times E = \frac{4.77}{4.77 + 14.44} \times 10$$

$$= 2.48 V$$

Calculating voltage of R_1, R_2 and R_3

$$\therefore VR_1 = \frac{R_1}{R_1 + R_p} \times E = \frac{4.77}{4.77 + 14.44} \times 10$$

$$= 2.48 V$$

$$\therefore VR_2 = \frac{R_2}{R_2 + R_p} \times E = \frac{4.77}{4.77 + 14.44} \times 10$$

$$= 2.48 V$$

$$\therefore VR_3 = \frac{R_3}{R_3 + R_p} \times E = \frac{4.77}{4.77 \times 14.44} \times 10$$

$$= 2.48 V$$

Readings	circuit-2 (volt)	% Error
V_{AD}	9.96	4
V_{BD}	5.02	10
V_{CD}	5.04	6
V_{AB}	4.93	1
V_{BC}	0.01	1
V_{AC}	4.91	1

here, we calculated the value of V_{AB}, V_{BD}, V_{CD}, V_{AB}, V_{BC}, V_{AC} and the following errors.

In table-2, circuit-1 can be said to be equivalent. If we see the table 2, we find out that the values of V_{AD} in circuit 1 and 2 are 9.82 and 9.96.

$9.82 \simeq 9.96$. again, from V_{AB} the values are $4.92 \simeq 4.93$. These are also close to equivalent.

That's why, we can say that ~~Del~~ Delta-Wye conversion was sucessful enough to prove that statement worthy.

Result and Discussion:

In the conversion of Delta-Wye, some terminals of Wye and Delta circuit have identical values. Although the Delta and Wye have the same total resistance. They still have ~~included~~ individual but different resistors. A bridge circuit can be simplified to a series or parallel circuit using Delta-Wye network. Through theoritical and measured values are not exactly same but they are close enough to each other. So a difficult value can be easily done through

Δ-Y transformation by doing some step.

Conclusion:

In this experiment, we have learned the delta-wye transformation. This is a useful technique in circuit in circuit analysis in transforming a circuit to reduce in simplier circuit but of course the ~~resistor~~ resistance will be constant before transformation The circuit Delta-Wye is equivalent to each other but the arrangement of the resistance in the circuit will be different values.

List of Equipment

- Trainer Board
- DMM
- 5 x 15kΩ resistor
- 3 x 5 kΩ resistor

Procedure

1. Measure the resistor values with DMM and note down in Table 1.
2. Setup the circuit as shown in the circuit 1
3. Measure the voltage V_{AD} , V_{BD}, V_{CD} (D is the reference node) and note down in Table 2
4. Measure the voltage V_{AB} , V_{BC}, V_{AC} and note down in Table 2
5. Setup Circuit 2.
6. Measure the voltage V_{AD} , V_{BD}, V_{CD} (D is the reference node) and note down in Table 2
7. Measure the voltage V_{AB} , V_{BC}, V_{AC} and note down in Table 2

Data Collection for Lab 5:

Group No. ________
Instructor's Signature __________

Table 1:

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04/07/2018