ELEMENTS OF ELECTRICAL ENGINEERING
UE24EE141B

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Lectures 8 & 9 - Star Delta Transformations

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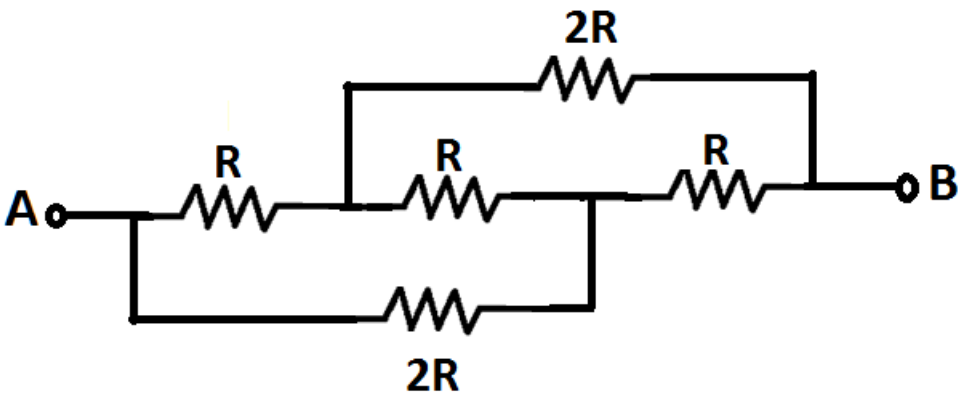
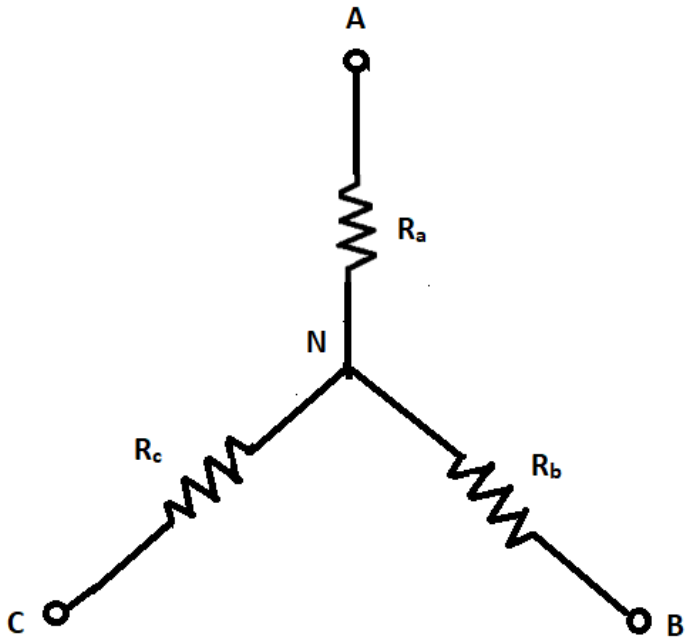
Need for Star Delta Transformations

Sometimes resistors can neither be combined in series nor parallel.

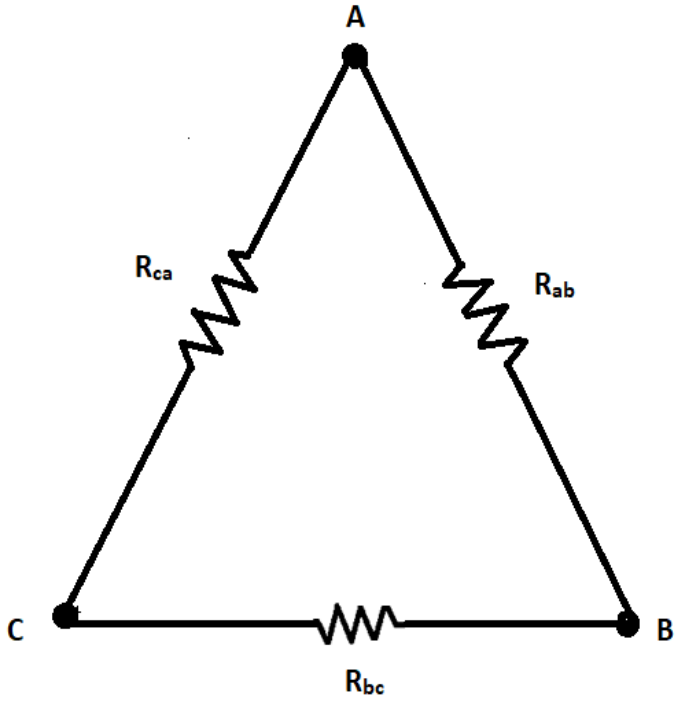
For instance, consider the following network:



Star and Delta Connection of Resistors

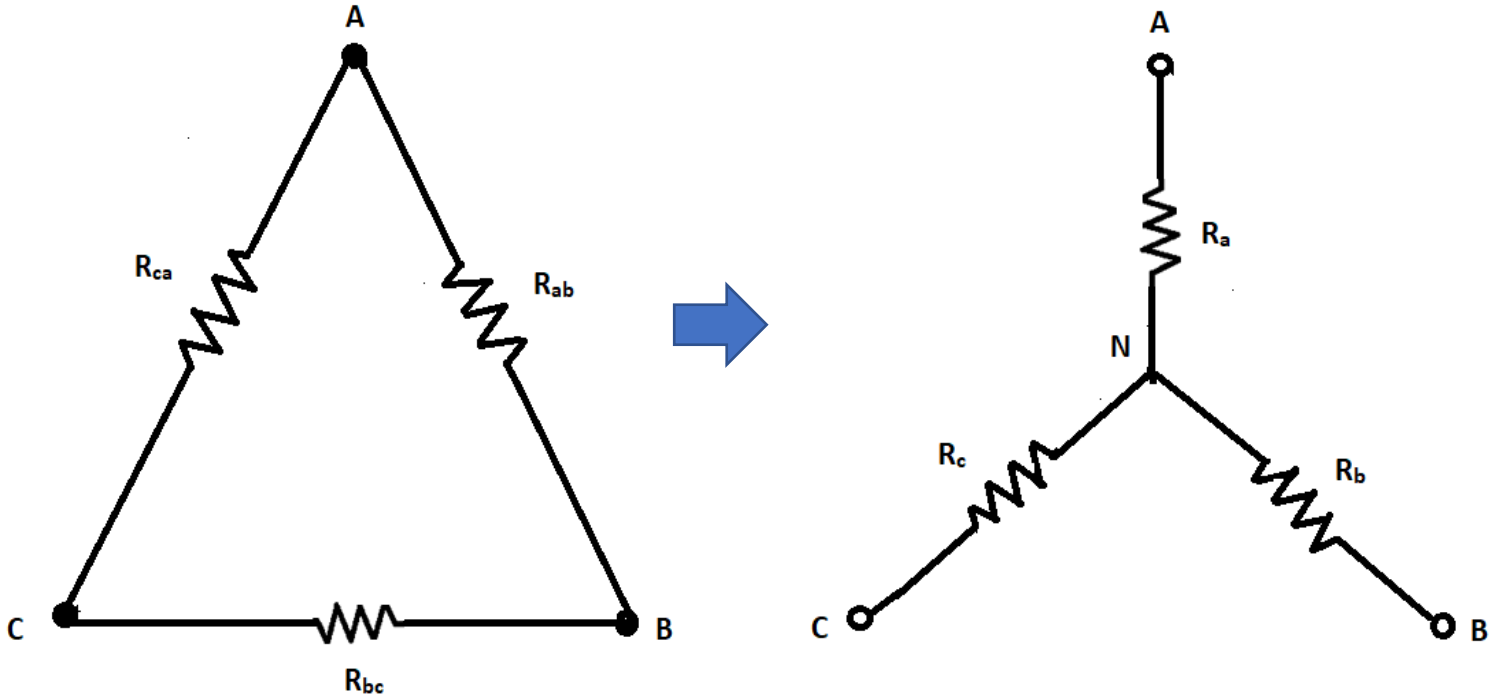


STAR (OR) WYE CONNECTION



DELTA (OR) MESH CONNECTION

Delta to Star Transformation



Equivalent resistance between terminals A & B:

For Delta, it is $\frac{R_{ab}*(R_{bc}+R_{ca})}{(R_{ab}+R_{bc}+R_{ca})}$

For Star, it is (R_a+R_b)

Delta to Star Transformation

Since for the transformation, they must be equivalent,

$$(R_a+R_b) = \frac{R_{ab}*(R_{bc}+R_{ca})}{(R_{ab}+R_{bc}+R_{ca})} \quad \text{----------} \quad (1)$$

Similarly between the terminals B & C

$$(R_b+R_c) = \frac{R_{bc}*(R_{ca}+R_{ab})}{(R_{ab}+R_{bc}+R_{ca})} \quad \text{----------} \quad (2)$$

Similarly between the terminals C & A

$$(R_c+R_a) = \frac{R_{ca}*(R_{ab}+R_{bc})}{(R_{ab}+R_{bc}+R_{ca})} \quad \text{----------} \quad (3)$$

Delta to Star Transformation

(1) – (2) + (3)

$$2R_a = \frac{2R_{ab}*R_{ca}}{(R_{ab}+R_{bc}+R_{ca})}$$

$$R_a = \frac{R_{ab}*R_{ca}}{(R_{ab}+R_{bc}+R_{ca})} \quad \text{----------} \quad (4)$$

$$R_b = \frac{R_{bc}*R_{ab}}{(R_{ab}+R_{bc}+R_{ca})} \quad \text{----------} \quad (5)$$

$$R_c = \frac{R_{ca}*R_{bc}}{(R_{ab}+R_{bc}+R_{ca})} \quad \text{----------} \quad (6)$$

Equations (4), (5), (6) represent Delta to Star Transformation

Star to Delta Transformation

Manipulating Equations (4), (5) & (6), we get the star to delta transformation equations as follows:

$$R_{ab} = \frac{R_a * R_b + R_b * R_c + R_c * R_a}{R_c} \quad \text{----------} \quad (7)$$

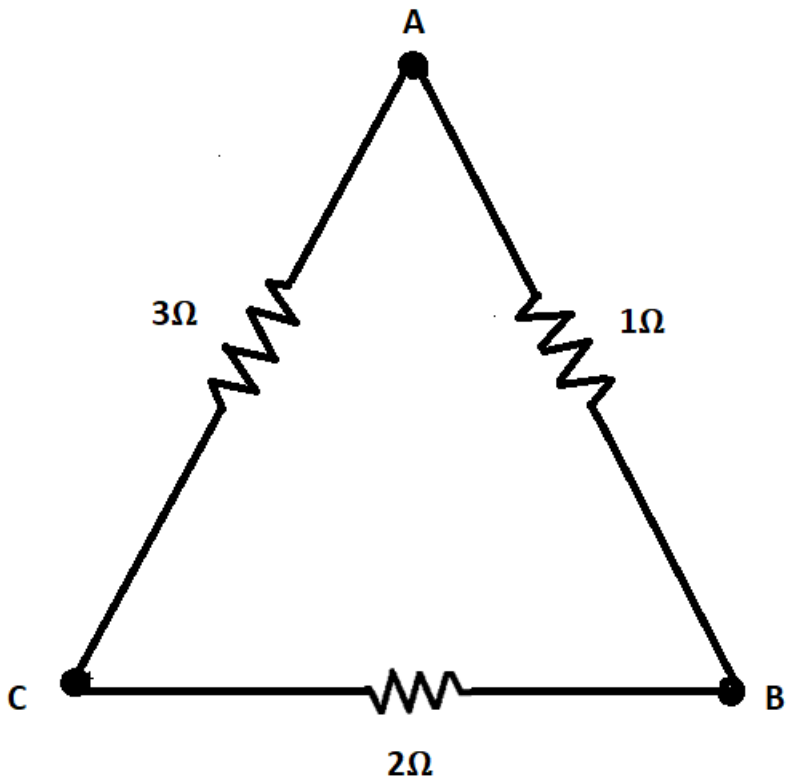
$$R_{bc} = \frac{R_a * R_b + R_b * R_c + R_c * R_a}{R_a} \quad \text{----------} \quad (8)$$

$$R_{ca} = \frac{R_a * R_b + R_b * R_c + R_c * R_a}{R_b} \quad \text{----------} \quad (9)$$

Equations (7), (8), (9) represent Star to Delta Transformation

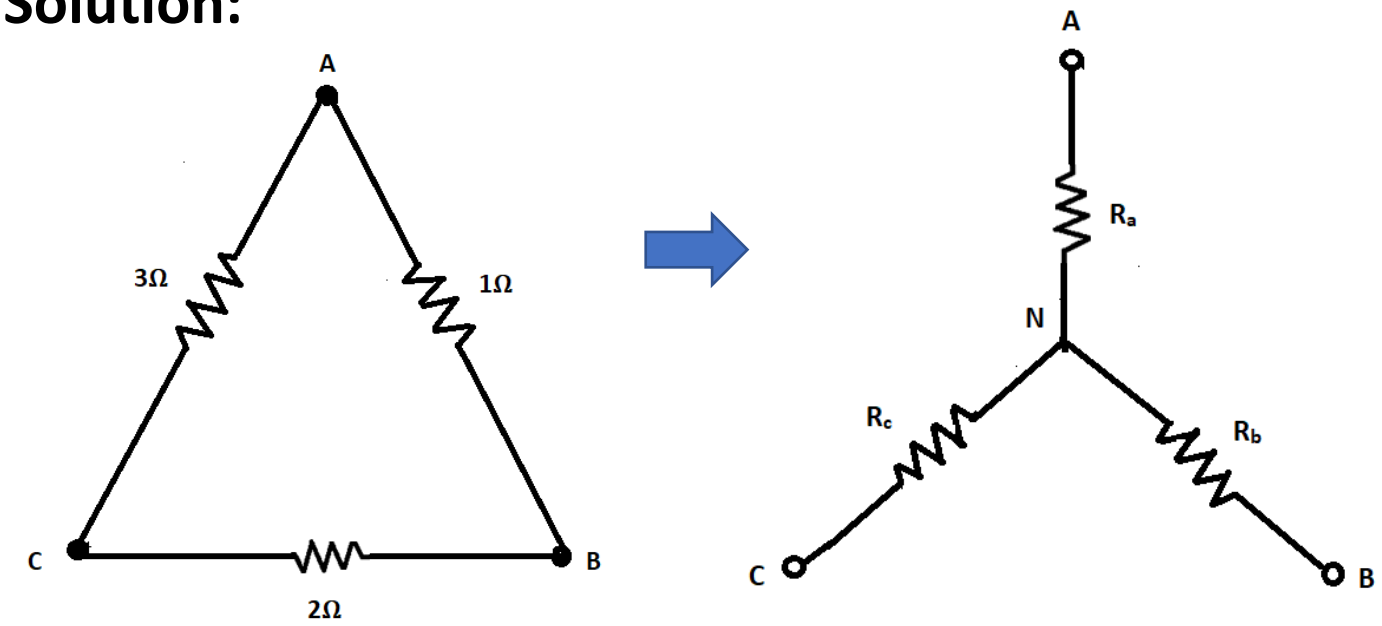
Simple Numerical Examples on Transformations

Example 1: Transform the given delta to equivalent star



Simple Numerical Examples on Transformations

Solution:

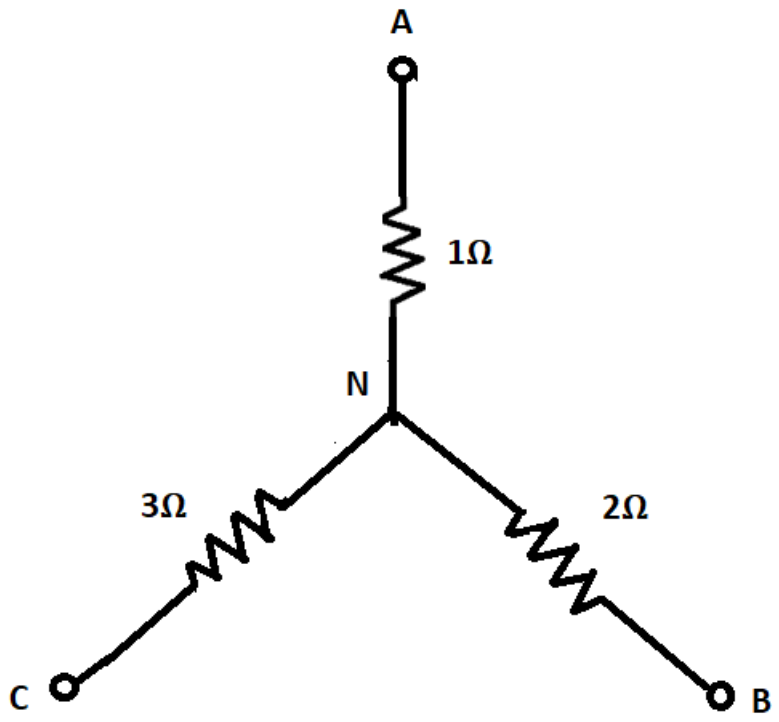


$$R_a = \frac{R_{ab} * R_{ca}}{(R_{ab} + R_{bc} + R_{ca})} = \frac{1*3}{(1+2+3)} = \frac{1}{2}\,\Omega$$

Similarly, $R_b = \frac{1*2}{(1+2+3)} = \frac{1}{3}\,\Omega$ & $R_c = \frac{2*3}{(1+2+3)} = 1\Omega$

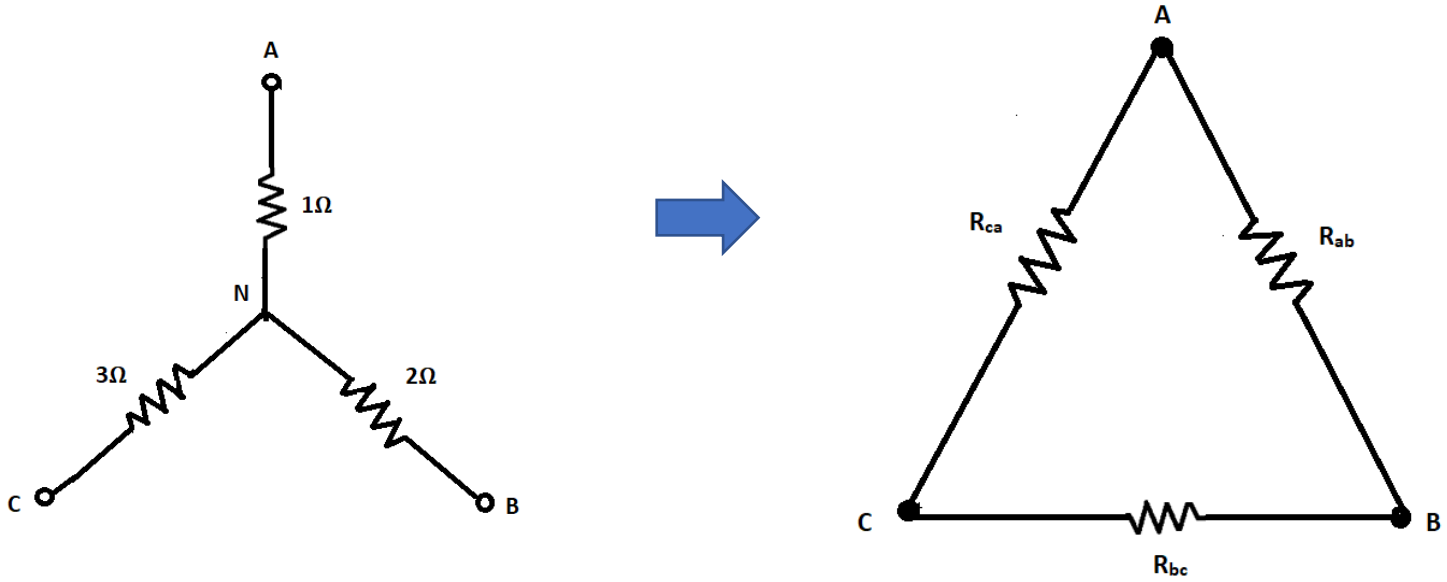
Simple Numerical Examples on Transformations

Example 2: Transform the given star to equivalent delta



Simple Numerical Examples on Transformations

Solution:



$$R_{ab} = \frac{R_a * R_b + R_b * R_c + R_c * R_a}{R_c} = \frac{1*2+2*3+3*1}{(3)} = \frac{11}{3}\ \Omega$$

Similarly, $R_{bc} = \frac{11}{(R_a)} = 11\ \Omega$ & $R_{ca} = \frac{11}{(R_b)} = \frac{11}{2}\ \Omega$

Text Book & References

Text Book:

"Electrical and Electronic Technology" E. Hughes (Revised by J. Hiley, K. Brown & I.M Smith), 11th Edition, Pearson Education, 2012.

Reference Books:

1. "Basic Electrical Engineering", K Uma Rao, Pearson Education, 2011.
2. "Basic Electrical Engineering - Revised Edition", D. C. Kulshreshta, Tata- McGraw-Hill, 2012.
3. "Engineering Circuit Analysis", William Hayt Jr., Jack E. Kemmerly & Steven M. Durbin, 8th Edition, McGraw-Hill, 2012.

THANK YOU

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