



ELEMENTS OF ELECTRICAL ENGINEERING

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Star Delta Transformations

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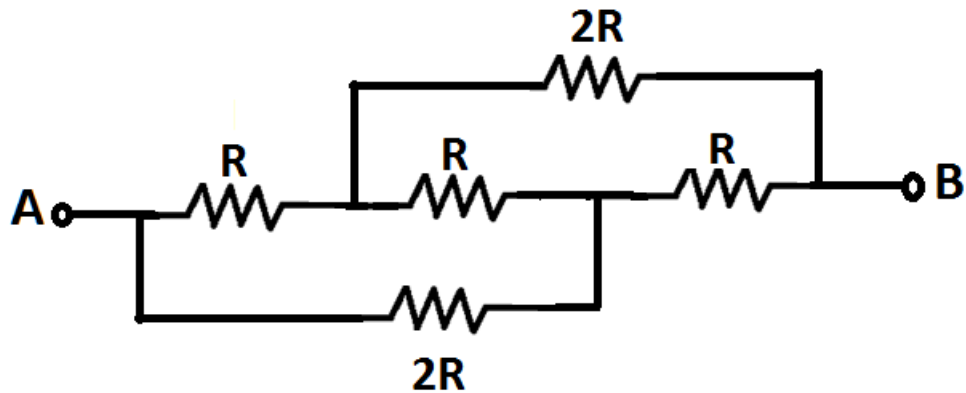
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Need for Star Delta Transformations

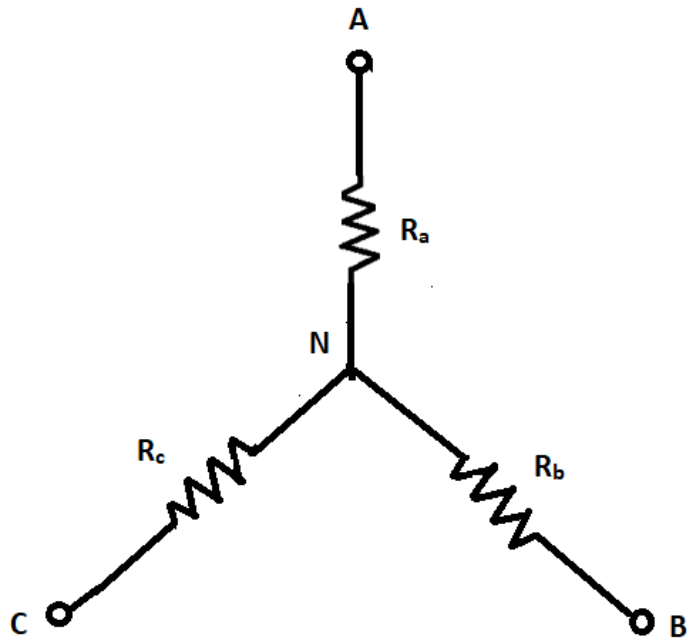
Sometimes resistors can neither be combined in series nor parallel.

For instance, consider the following network:

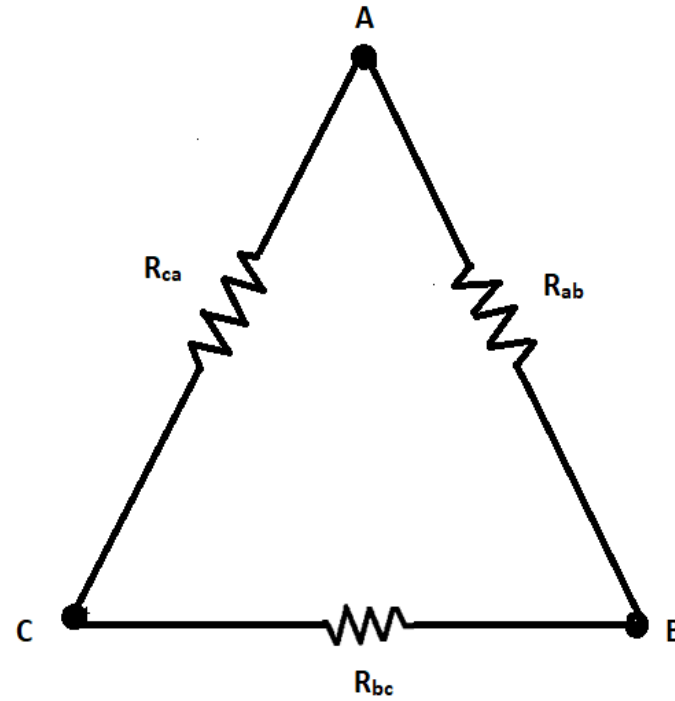


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Star and Delta Connection of Resistors



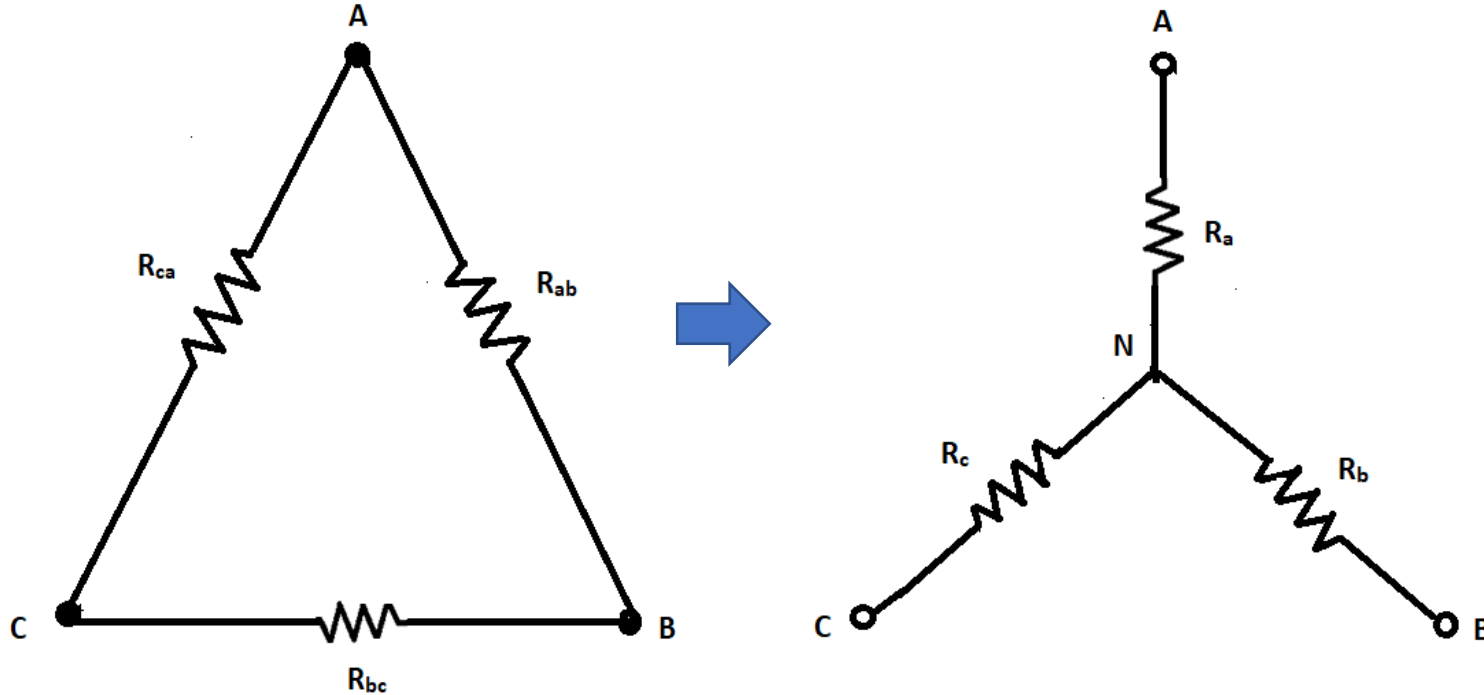
STAR (OR) WYE
CONNECTION



DELTA (OR) MESH
CONNECTION

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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 $(R_a + R_b)$

Since for the transformation, they must be equivalent,

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

Similarly between the terminals B & C

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

Similarly between the terminals C & A

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

$$(1) - (2) + (3)$$

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

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

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

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

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

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

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

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

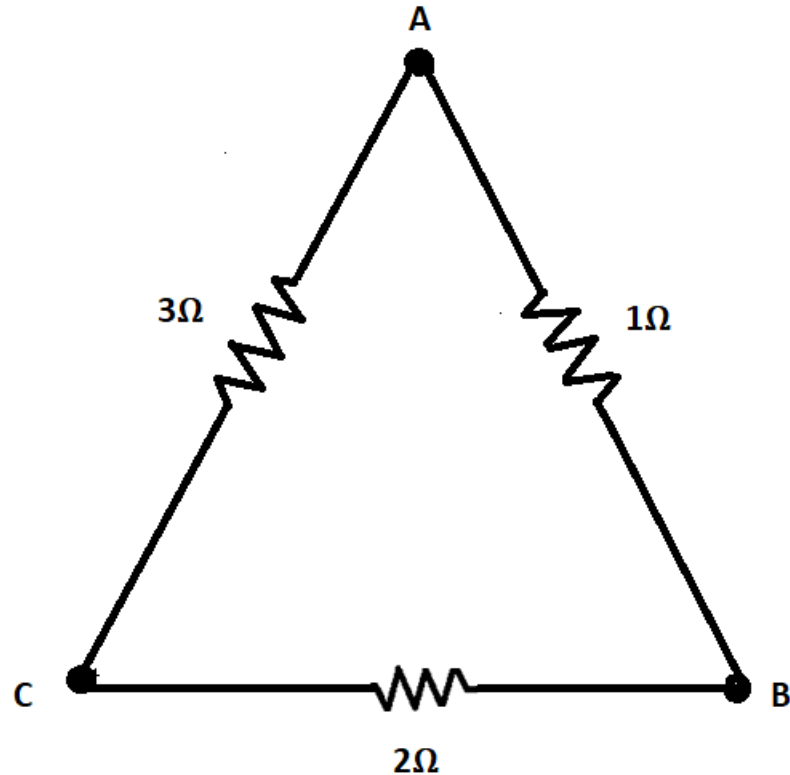
$$R_{ca} = \frac{R_a * R_b + R_b * R_c + R_c * R_a}{R_b} \text{ ----- (9)}$$

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

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Simple Numerical Examples on Transformations

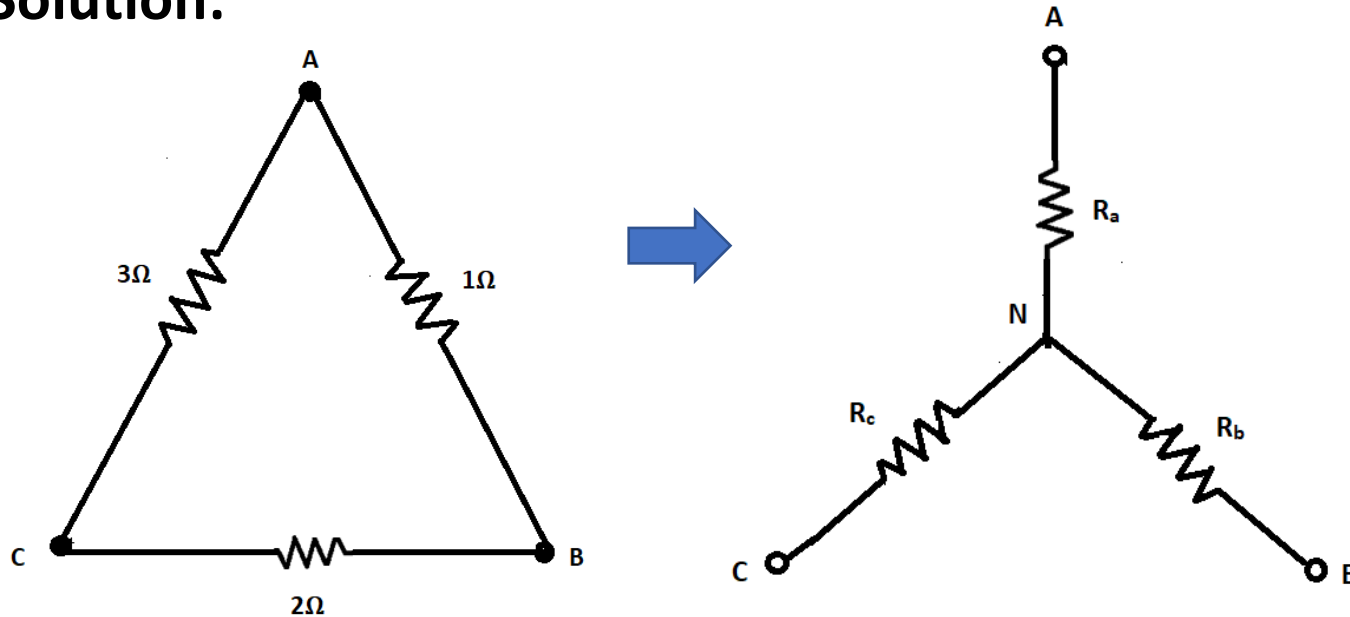
Example 1: Transform the given delta to equivalent star



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Simple Numerical Examples on Transformations

Solution:



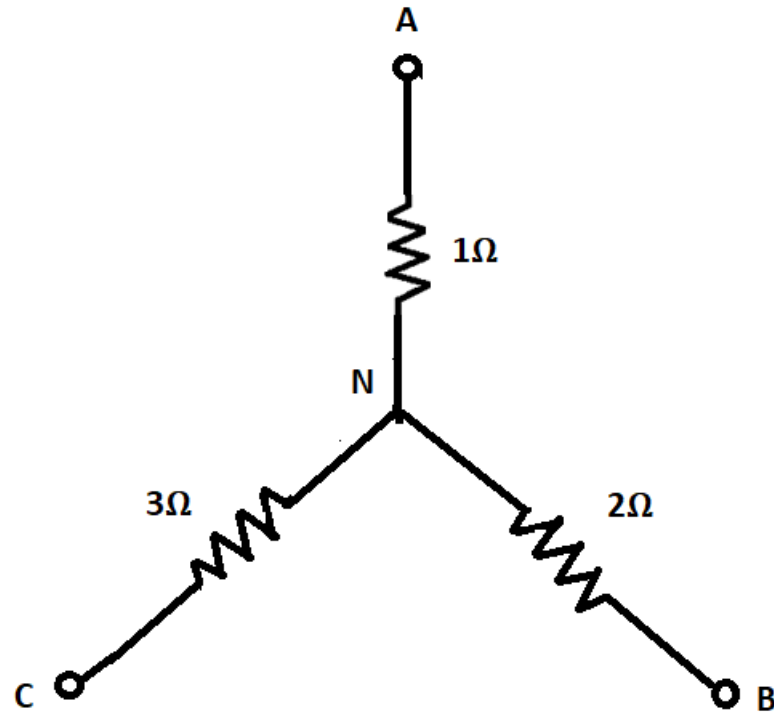
$$R_a = \frac{R_{ab} * R_{ca}}{(R_{ab} + R_{bc} + R_{ca})} = \frac{1 * 3}{(1 + 2 + 3)} = \frac{1}{2} \Omega$$

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

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Simple Numerical Examples on Transformations

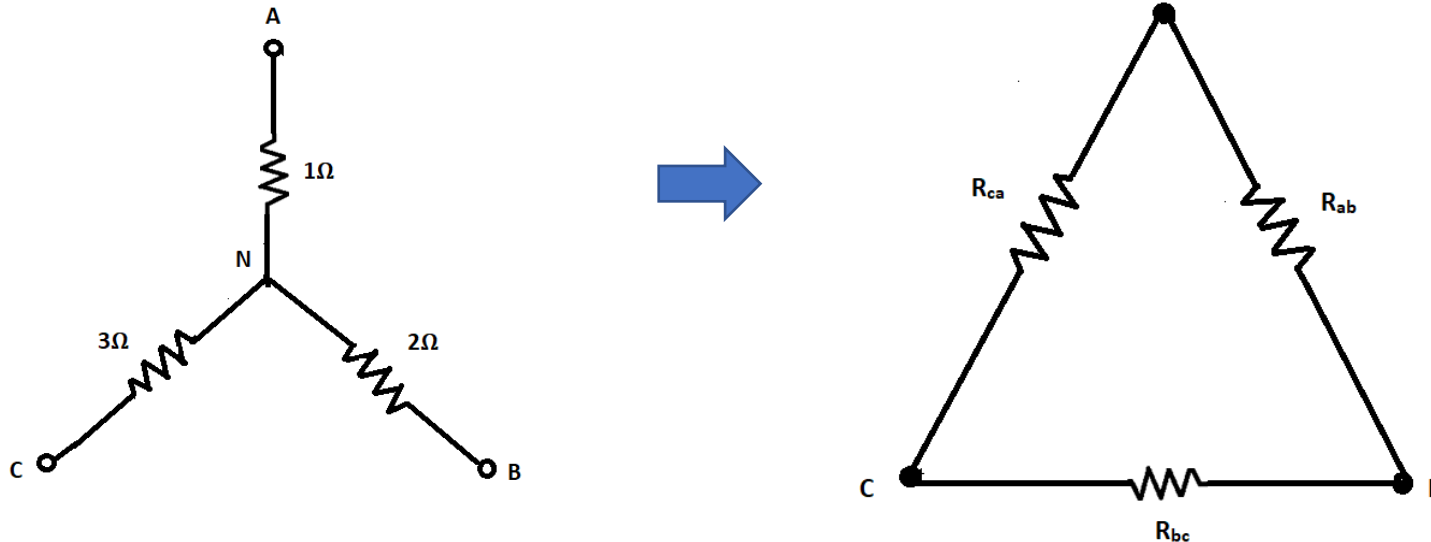
Example 2: Transform the given star to equivalent delta



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Simple Numerical Examples on Transformations

Solution:



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

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

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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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