ELEMENTS OF ELECTRICAL ENGINEERING
Course Code : UE25EE141A/B

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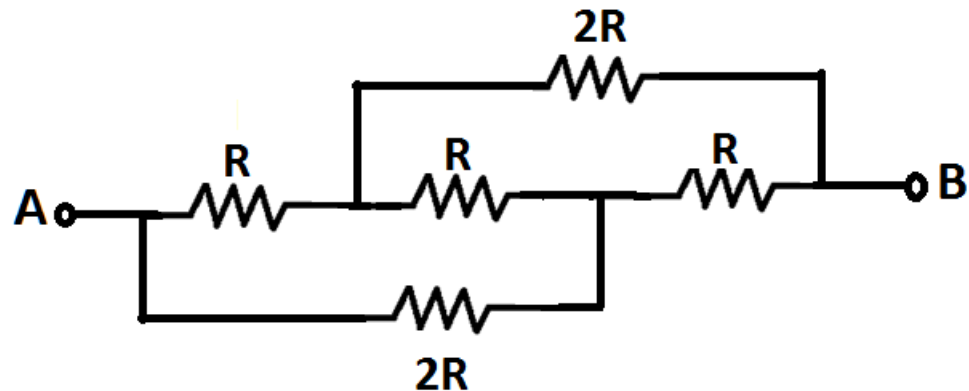Prof. Sangam Kumar G H

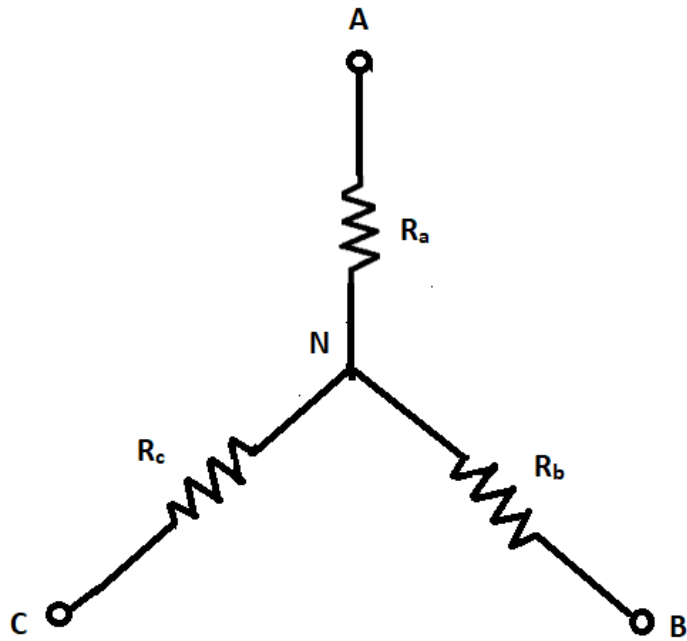# ELEMENTS OF ELECTRICAL ENGINEERING

Star Delta Transformations

Jyothi T N

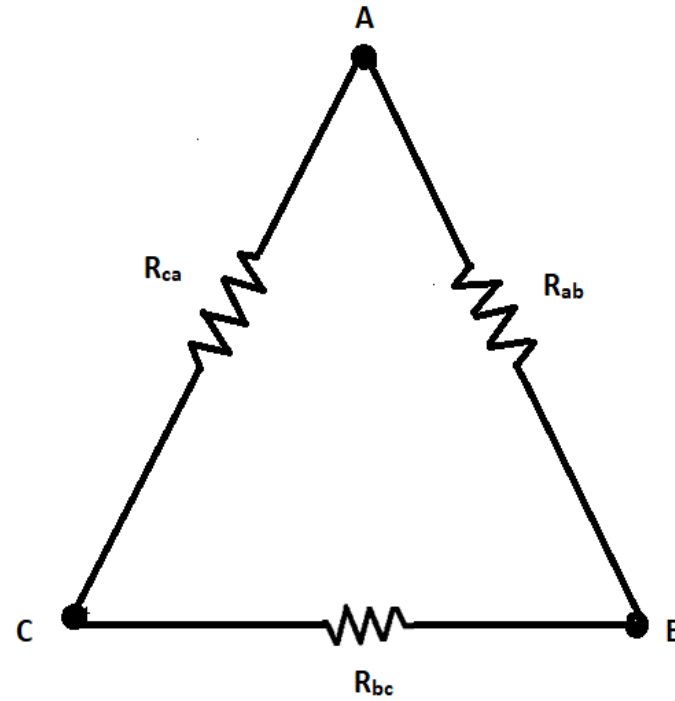Department of Electrical & Electronics Engineering

Sometimes resistors can neither be combined in series nor parallel.

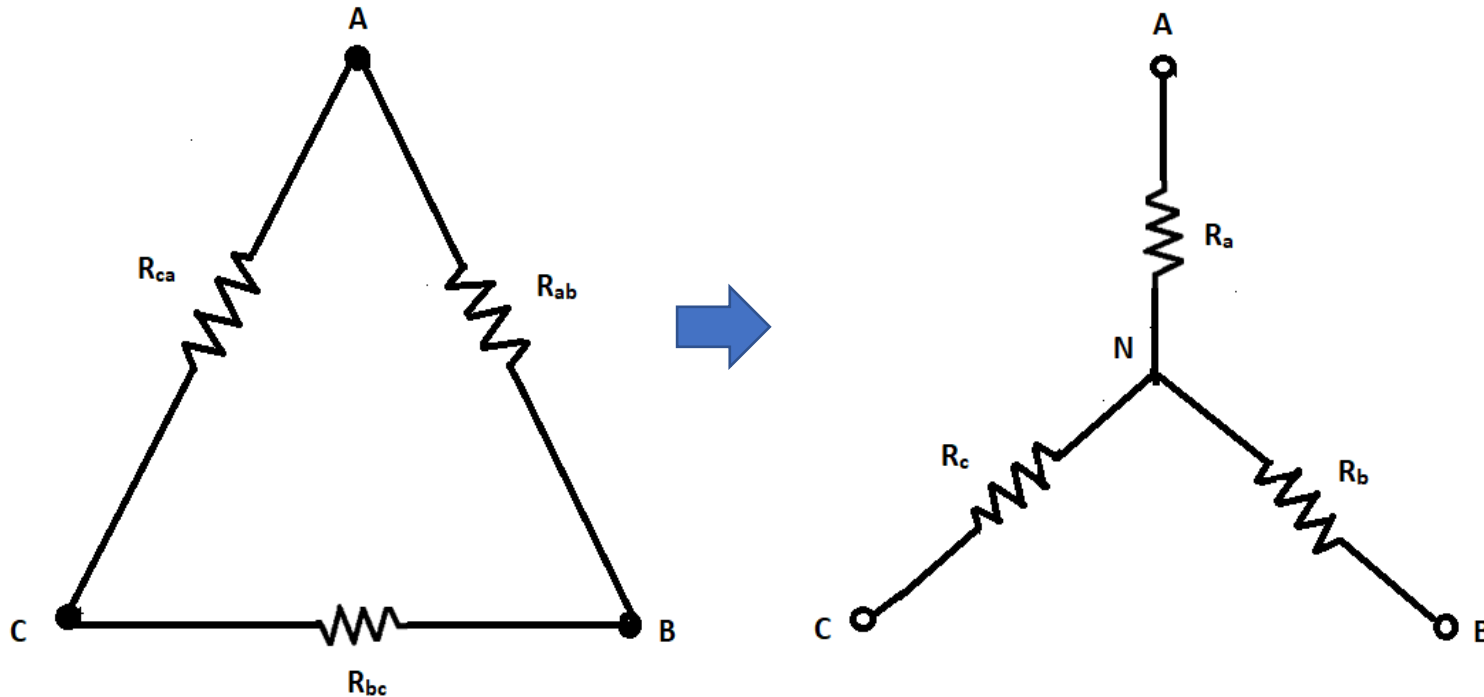For instance, consider the following network:

STAR (OR) WYE
CONNECTION

DELTA (OR) MESH
CONNECTION

Equivalent resistance between terminals A & B:

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

For Star, it is (R_a+R_b)

Since for the transformation, they must be equivalent,

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

Similarly between the terminals B & C

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

Similarly between the terminals C & A

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

(1) − (2) + (3)

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

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

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

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

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

Manipulating Equations (4), (5) & (6), we get the star to delta transformation equations as follows:
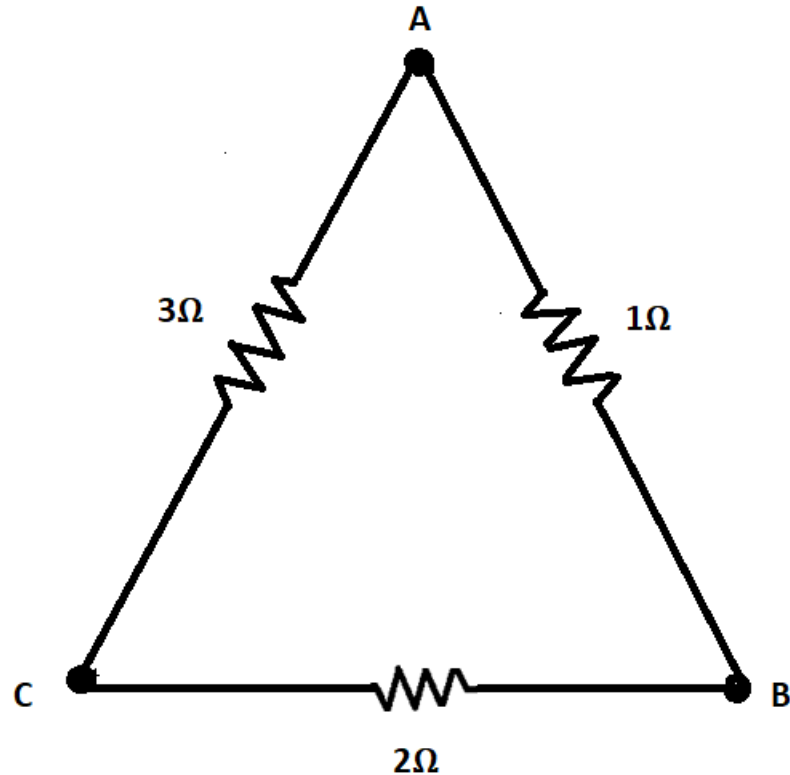
$$R_{ab} = \frac{R_a * R_b + R_b * R_c + R_c * R_a}{R_c} \quad \text{------------} \quad (7)$$

$$R_{bc} = \frac{R_a * R_b + R_b * R_c + R_c * R_a}{R_a} \quad \text{------------} \quad (8)$$
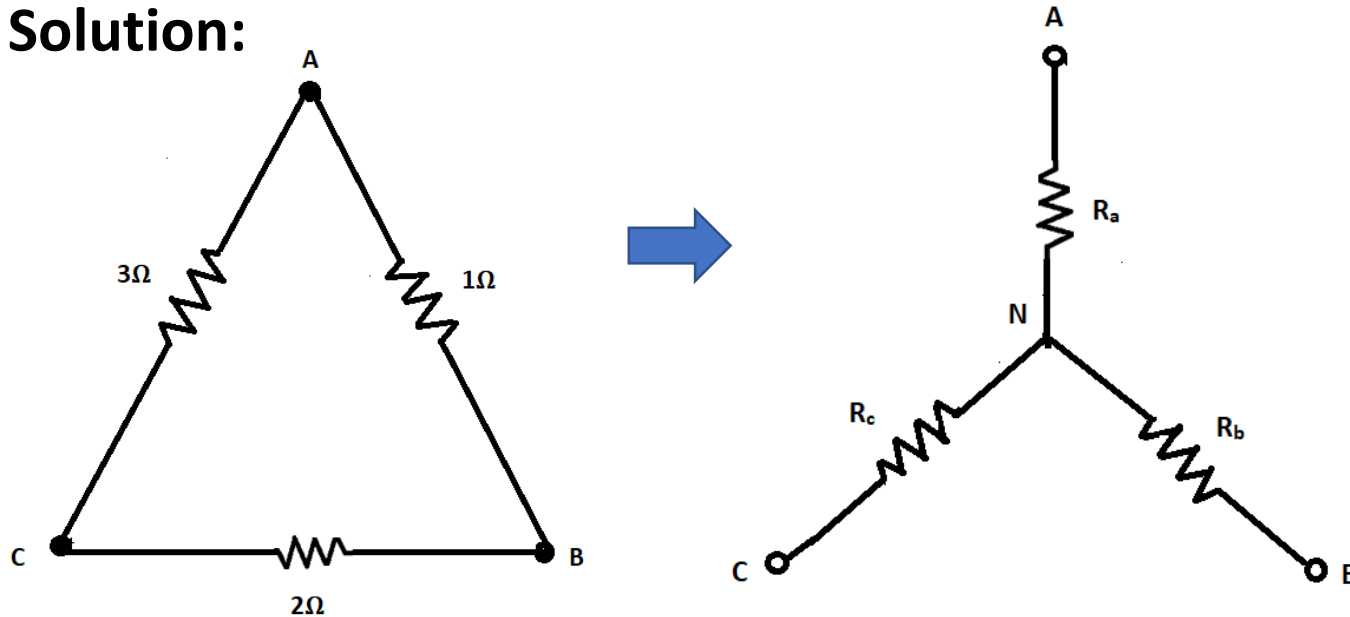
$$R_{ca} = \frac{R_a * R_b + R_b * R_c + R_c * R_a}{R_b} \quad \text{------------} \quad (9)$$

Equations (7), (8), (9) represent Star to Delta Transformation
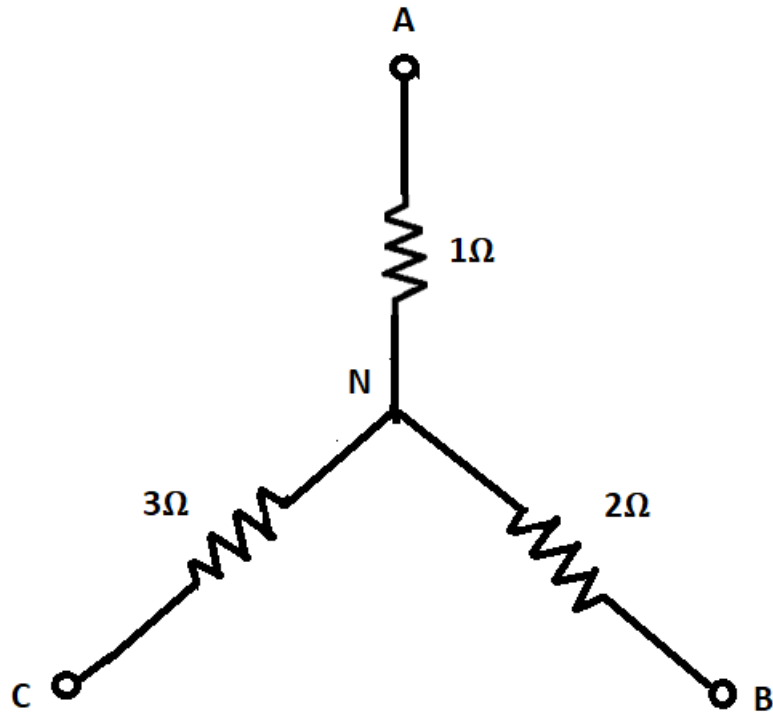
Example 1: Transform the given delta to equivalent star

Solution:

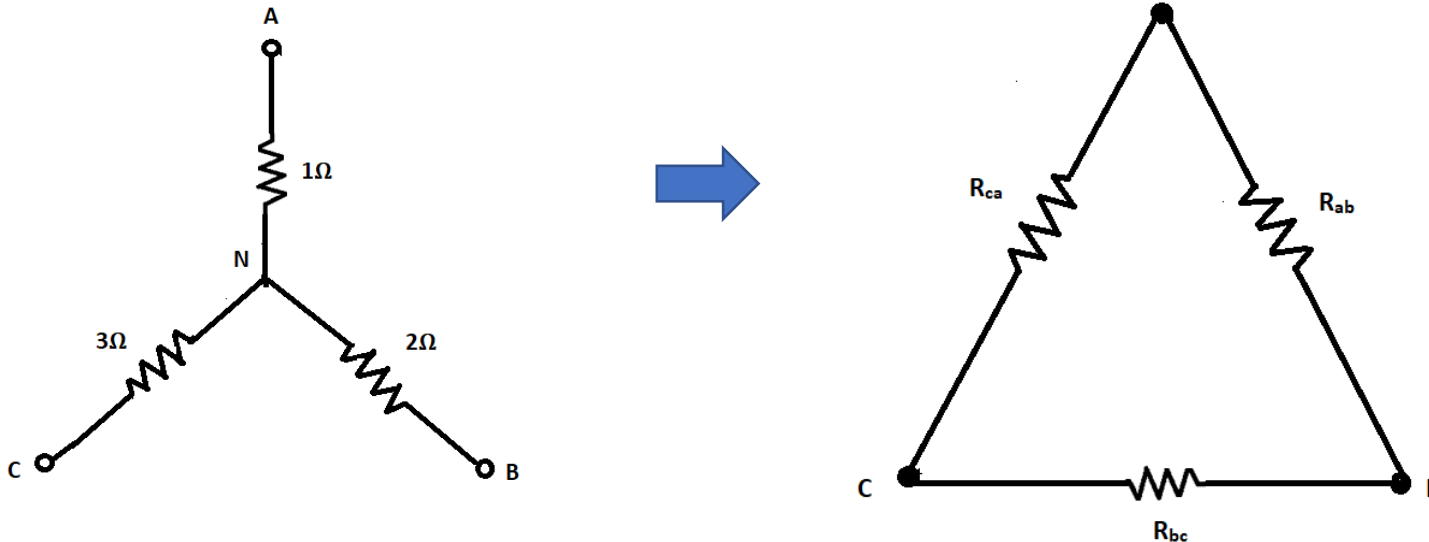

$$R_a = \frac{R_{ab}*R_{ca}}{(R_{ab}+R_{bc}+R_{ca})} = \frac{1*3}{(1+2+3)} = \frac{1}{2}\ \Omega$$

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

Example 2: Transform the given star to equivalent delta

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

Text Book:

1. "Basic Electrical Engineering" S.K Bhattacharya, 1st Edition Pearson India Education Services Pvt. Ltd., 2017

2. "Basic Electrical Engineering", D. C. Kulshreshta, 2nd Edition, McGraw-Hill. 2019

3. "Special Electrical Machines" E G Janardanan, PHI Learning Pvt. Ltd., 2014

Reference Books:

1. "Engineering Circuit Analysis" William Hayt, Jack Kemmerly, Jamie Phillips and Steven Durbin, 10th Edition McGraw Hill, 2023

2. "Electrical and Electronic Technology" E. Hughes (Revised by J. Hiley, K. Brown & I.M Smith), 12th Edition, Pearson Education, 2016.

THANK YOU

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