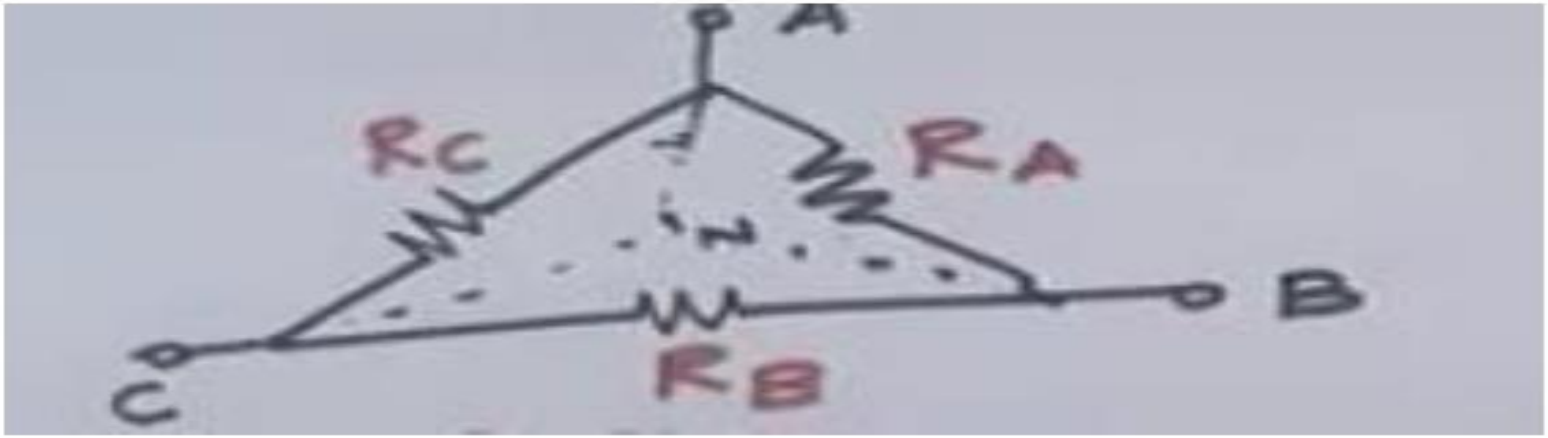
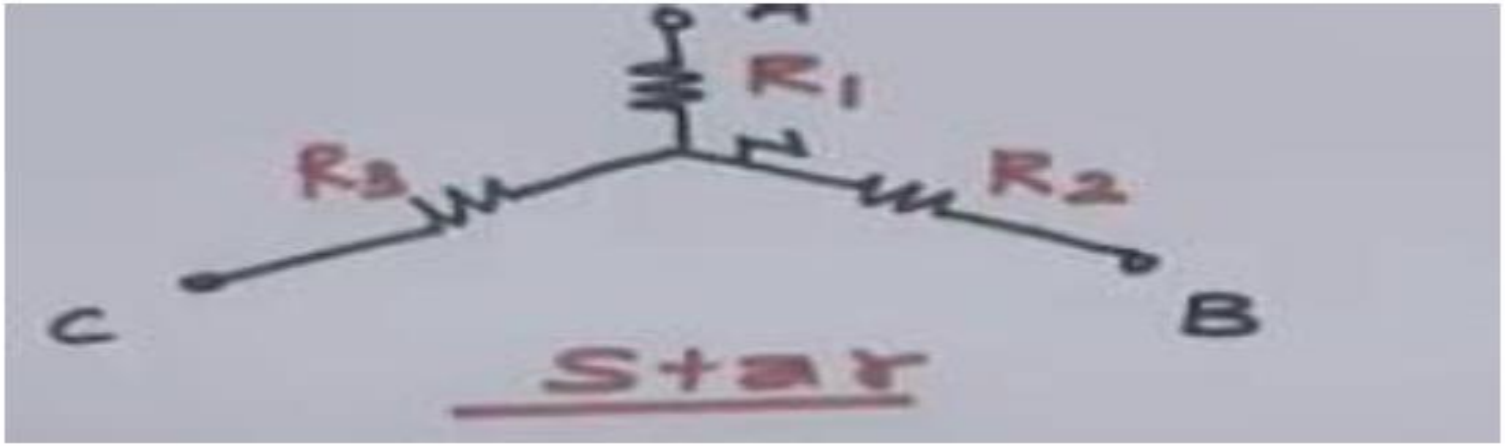
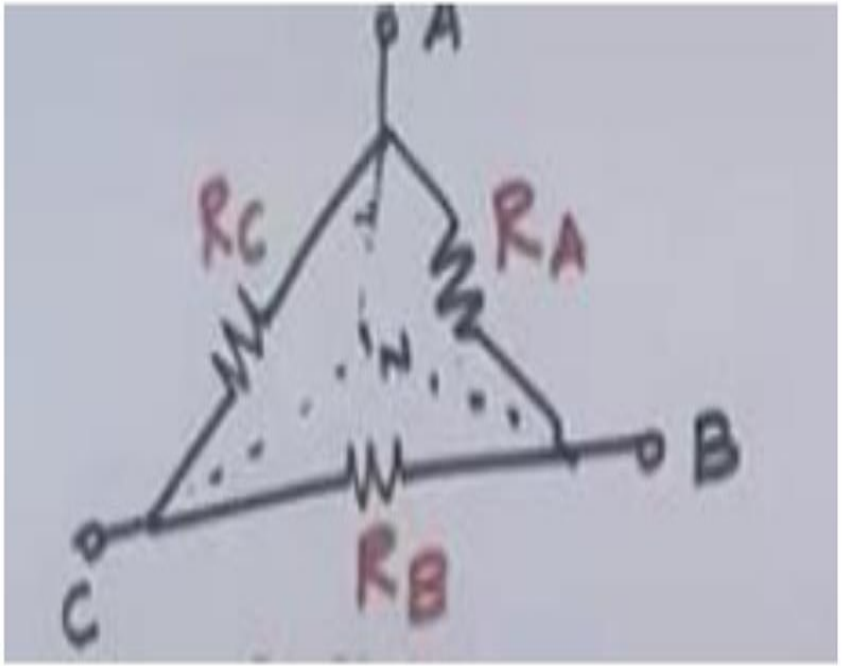
Star Delta Transformation

In delta connection, three branches are connected nose to tail, they form a triangular closed loop, this configuration is referred as delta connection.



When either terminal of three branches is connected to a common point to form a Y like pattern is known as **star connection.**





Delta to star conversion

Eq. Resist. betn A & B :-

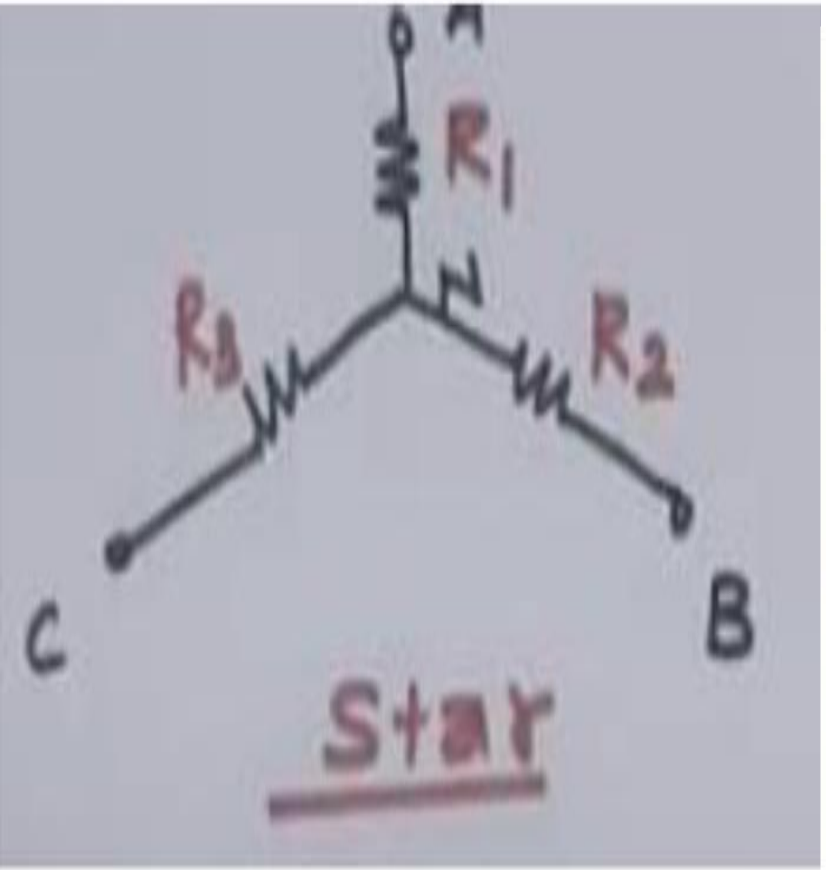
$$= R_A \parallel (R_B+R_C) = \frac{R_A(R_B+R_C)}{R_A+R_B+R_C} \quad \text{--- (1)}$$

similarly, Eq. Resist. betn B & C :-

$$= R_B \parallel (R_C+R_A) = \frac{R_B(R_C+R_A)}{R_B+R_C+R_A} \quad \text{--- (2)}$$

& Eq. Resist. betn C & A :-

$$= R_C \parallel (R_A+R_B) = \frac{R_C(R_A+R_B)}{R_C+R_A+R_B} \quad \text{--- (3)}$$



Eq. Resist. bet^n A & B

$R_1 + R_2$ — (4)

Similarly,

B

Eq. Resist. bet^n B & C

$= R_2 + R_3$ — (5)

& Eq. Resist. bet^n C & A

$= R_3 + R_1$ — (6)

Equating (1) & (4)

$$\frac{R_A(R_B+R_C)}{R_A+R_B+R_C} = R_1+R_2 \quad \text{—} (7)$$

Equating (2) & (5)

$$\frac{R_B(R_C+R_A)}{R_A+R_B+R_C} = R_2+R_3 \quad \text{—} (8)$$

Equating (3) & (6)

$$\frac{R_C(R_A+R_B)}{R_A+R_B+R_C} = R_3+R_1 \quad \text{—} (9)$$

Equation 7 — 8

$$\frac{R_A(R_B+R_C) - R_B(R_C+R_A)}{R_A+R_B+R_C} = R_1 - R_3 \quad \text{— (10)}$$

Adding Equn 9 & 10

$$\frac{R_C\cdot R_A + \cancel{R_C R_B} + \cancel{R_A\cdot R_B} + R_A\cdot R_C - \cancel{R_B R_C} - \cancel{R_B R_A}}{R_A+R_B+R_C} = 2R_1$$

$$\frac{\cancel{2}\cdot R_A R_C}{R_A+R_B+R_C} = \cancel{2}R_1$$

$$\boxed{R_1 = \frac{R_A\cdot R_C}{R_A+R_B+R_C}}$$

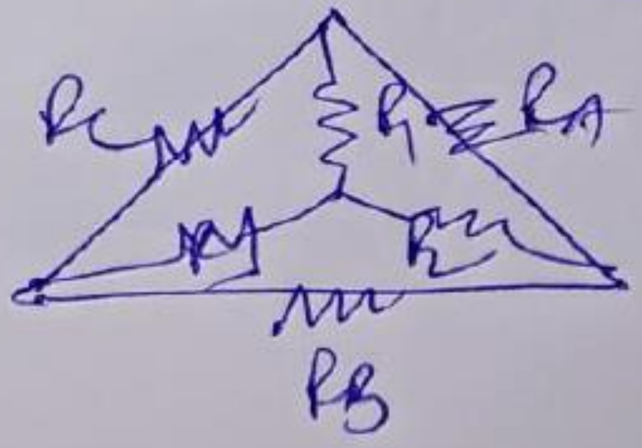
Similarly,

$$\boxed{R_2 = \frac{R_A \cdot R_B}{R_A + R_B + R_C}}$$

&

$$R_3 = \frac{R_B \cdot R_C}{R_A + R_B + R_C}$$

Delta to Star



$$R_1 = \frac{\text{opp Res}}{\text{total}}$$

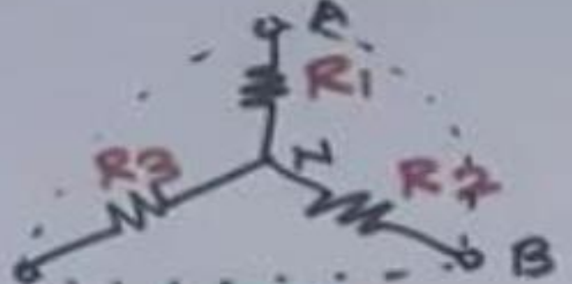
$$R_1 = \frac{R_A R_C}{R_A + R_B + R_C}$$

$$R_2 = \frac{R_A R_B}{R_A + R_B + R_C}$$

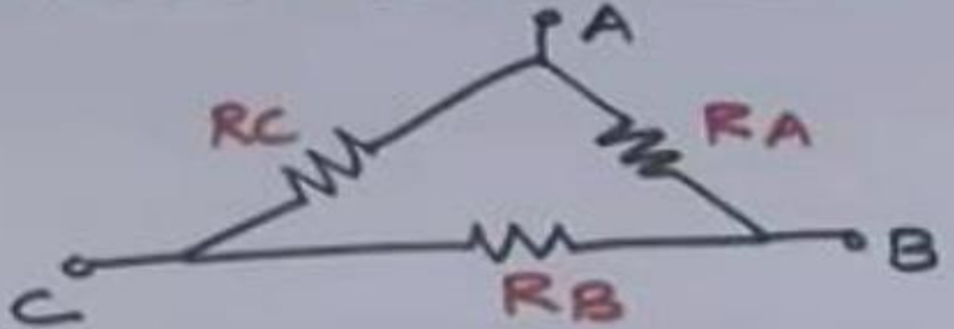
$$R_3 = \frac{R_B \cdot R_C}{R_A + R_B + R_C}$$

Star to delta

Star to Delta Conversion



Star



Delta

$$R_1 = \frac{R_A R_C}{R_A + R_B + R_C} \; ; \; R_2 = \frac{R_A R_B}{R_A + R_B + R_C} \; ; \; R_3 = \frac{R_B \cdot R_C}{R_A + R_B + R_C}$$

$$R_1 \cdot R_2 + R_2 \cdot R_3 + R_3 \cdot R_1 = \frac{R_A^2 \cdot R_B \cdot R_C + R_A \cdot R_B^2 \cdot R_C + R_A R_B R}{(R_A + R_B + R_C)^2}$$

$$= \frac{R_A R_B R_C \, (R_A + R_B + R_C)}{(R_A + R_B + R_C)^2}$$

$$R_1 = \frac{R_A R_C}{R_A + R_B + R_C} \; ; \; R_2 = \frac{R_A R_B}{R_A + R_B + R_C} \; ; \; R_3 = \frac{R_B \cdot R_C}{R_A + R_B + R_C}$$

$$R_1 \cdot R_2 + R_2 \cdot R_3 + R_3 \cdot R_1 = \frac{R_A^2 \cdot R_B \cdot R_C + R_A \cdot R_B^2 \cdot R_C + R_A R_B R_C^2}{(R_A + R_B + R_C)^2}$$

$$= \frac{R_A R_B R_C \, \cancel{(R_A + R_B + R_C)}}{(R_A + R_B + R_C)^{\cancel{2}}}$$

$$R_1 R_2 + R_2 R_3 + R_3 R_1 = \frac{R_A \cdot R_B \cdot R_C}{(R_A + R_B + R_C)}$$

$$R_1 R_2 + R_2 R_3 + R_3 R_1 = R_A \cdot R_3$$

$$\frac{R_1 R_2}{R_3} + R_2 + R_1 = R_A$$

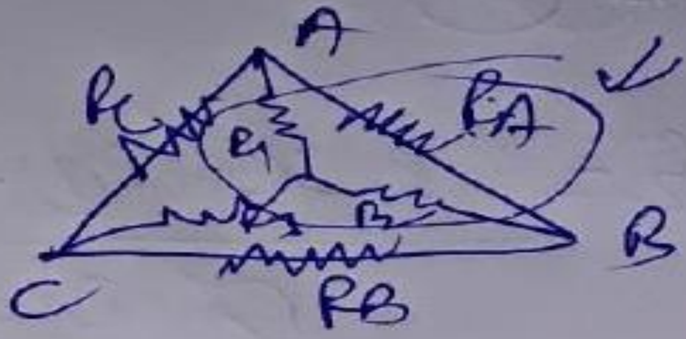
$$R_1 R_2 + R_2 R_3 + R_3 R_1 = R_A \cdot R_3$$

$$\boxed{\frac{R_1 R_2}{R_3} + R_2 + R_1 = R_A}$$

$$\boxed{R_2 + R_3 + \frac{R_2 R_3}{R_1} = R_B}$$

$$R_1 + R_3 + \frac{R_1 R_3}{R_2} = R_C$$

Star to Delta Conversion



$$\boxed{R_A = R_1 + R_2 + \frac{R_1 R_2}{R_3}}$$

[Sum of front Resistor + $\frac{\text{mult of front Res}}{R_3}$]

$$R_B = R_2 + R_3 + \frac{R_2 R_3}{R_1}$$

$$R_C = R_1 + R_3 + \frac{R_1 R_3}{R_2}$$