Source shifting.

i) shifting of voltage source.

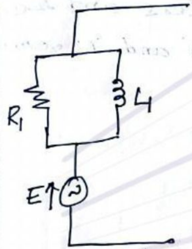

fig1(a)

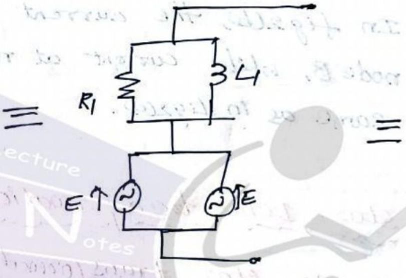

fig1(b)

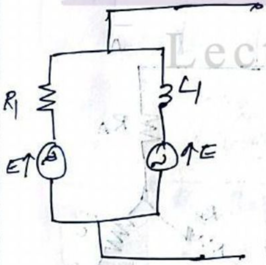

fig1(c)

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It is observed that source in fig1(a) is is pushed through the node in obtaining an equivalent network as shown in fig1(c).

ii) shifting of current source.

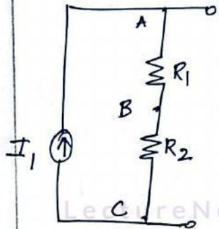

fig2(a)

≡

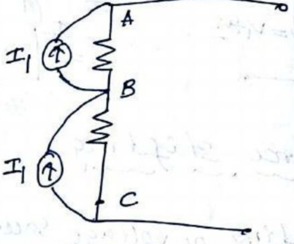

fig2(b).

In fig2(b), the current I_1 enters and leave node B, while current at node 'A' and 'C' remain same as in fig2(a).

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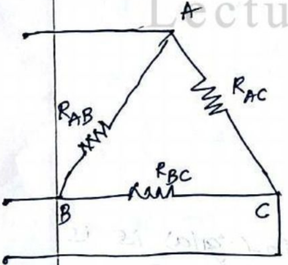
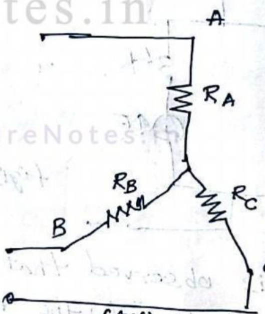
star- Delta transformations.

(i) Delta-to- star transformations (Δ-Y).



fig(a)

≡



fig(b)

are the three equivalent resistances connected in star as shown in fig(b).

The Equivalent resistance between A and B.

$$\therefore R_A + R_B = \frac{R_{AB}(R_{BC}+R_{CA})}{R_{AB}+R_{BC}+R_{CA}} \quad \text{——} \ ①$$

Between B & C,

$$\text{IIIy, } R_B + R_C = \frac{R_{BC}(R_{CA}+R_{AB})}{R_{AB}+R_{BC}+R_{AC}} \quad \text{——} ②$$

Between 'C' and 'A'

$$\text{IIIy, } R_C + R_A = \frac{R_{AC}(R_{AB}+R_{BC})}{R_{AB}+R_{BC}+R_{AC}} \quad \text{——} ③$$

eq① − eq②,

$$R_A - R_C = \frac{R_{AB}R_{CA} - R_{BC}R_{AC}}{R_{AB}+R_{BC}+R_{AC}} \quad \text{——} (4)$$

eq(3) + eq(4);

$$\cancel{2}R_A = \frac{\cancel{2}R_{AB}R_{AC}}{R_{AB}+R_{BC}+R_{AC}}$$

$$\boxed{R_A = \frac{R_{AB}R_{AC}}{R_{AB}+R_{BC}+R_{AC}}} \quad \text{——} (5)$$

ii) star-to-delta transformation (Y to Δ)

From eq(5), (7), (9), we can write

$$R_AR_B + R_BR_C + R_CR_A = \frac{R_{AB}R_{BC}R_{CA}(R_{AB}+R_{BC}+R_{CA})}{(R_{AB}+R_{BC}+R_{CA})^2}$$

Sub eq(5),

$$= \frac{R_{BC}}{\sum_1 R_{AB}} \times R_A \sum_1 R_{AB}$$

$$= R_A R_{BC}$$

$$\therefore R_{BC} = \frac{R_AR_B + R_BR_C + R_CR_A}{R_A}$$

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$$\boxed{R_{BC} = R_B + R_C + \frac{R_B R_C}{R_A}} \quad \text{—— (10)}$$

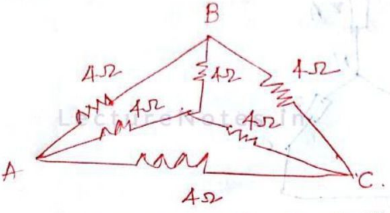
In similar way,

$$\boxed{R_{AB} = R_A + R_B + \frac{R_A R_B}{R_C}} \quad \text{—— (11)}$$

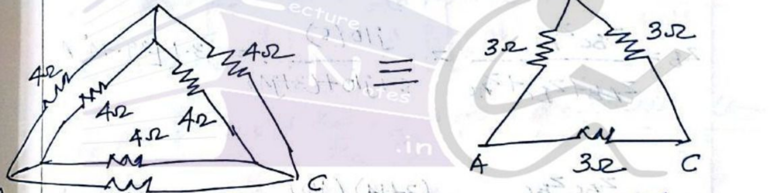
$$\boxed{R_{AC} = R_A + R_C + \frac{R_A R_C}{R_B}} \quad \text{—— (12)}.$$

Example problems:

1) six equall resistors each of 4Ω are connected as shown in fig below. Find the equivalent resistance between any two corners.



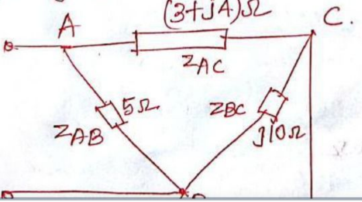
Sol:- The star network is converted into delta network

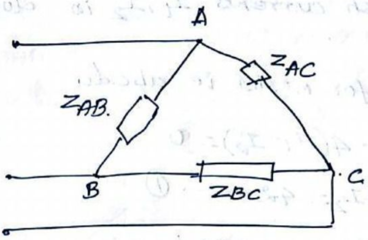


4Ω

The resistance b/w any two corners $= \frac{3\times 6}{3+6} = 2\Omega$.

2) obtain the star connected equivalent network for given delta connected network as shown in fig





$$Z_{AB} = Z_A + Z_B + \frac{Z_A Z_B}{Z_C}$$

$$= (4+j3) + (8-j6) + \frac{(4+j3)(8-j6)}{-j10}$$

$$Z_{AB} = 12.17 \angle 9.46^\circ \Omega.$$

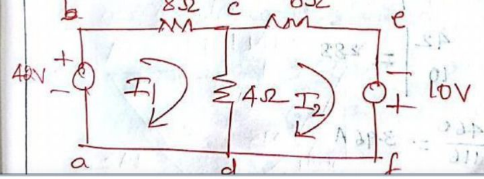
$$Z_{BC} = Z_B + Z_C + \frac{Z_B Z_C}{Z_A} = (8-j6) + (-j10) + \frac{(8-j6)(-j10)}{4+j3}$$

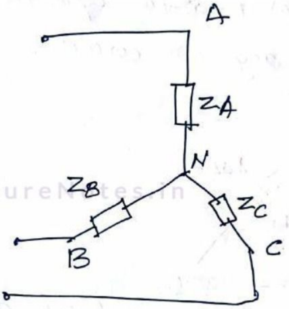
$$Z_{BC} = 24.8 \angle -117.44^\circ \Omega$$

$$Z_{AC} = Z_A + Z_B + \frac{Z_A Z_B}{Z_C} = (4+j3) + (8-j6) + \frac{(4+j3)(8-j6)}{-j10}$$

$Z_{AC} = 12.17 \angle -43.67° \Omega$

4) Using mesh current analysis, find the currents in the various branches of circuit shown in fig,



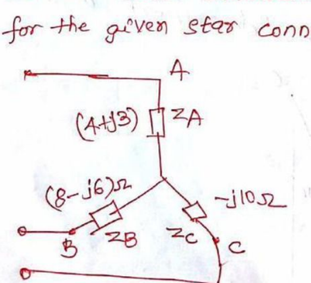


$$Z_A = \frac{Z_{AB} Z_{AC}}{Z_{AB}+Z_{BC}+Z_{CA}} = \frac{5(3+j4)}{5+j10+(3+j4)} = 1.55 \angle -7.13° A$$

$$Z_B = \frac{Z_{BC} Z_{AB}}{Z_{AB}+Z_{BC}+Z_{AC}} = \frac{j10(5)}{5+j10+(3+j4)} = 3.1 \angle 29.74° A$$

$$Z_C = \frac{Z_{AC} Z_{BC}}{Z_{AB}+Z_{BC}+Z_{AC}} = \frac{(3+j4)(j10)}{5+j10+3+j4} = 3.1 \angle 82.87° A.$$

3) obtain delta connected equivalent network for the given star connected network as shown.



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