Module Title: Fundamental of Electrical Engineering (DC)

Module Code:	**UOMU024011**

Chapter 2

Week (5, 6) Review Questions with answer

Solve problems on Delta star and star delta connection

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2.6 Wye-Delta Transformations

Situations often arise in circuit analysis when the resistors are neither in parallel nor in series, For example , the circuit shown in figure (15-2):-

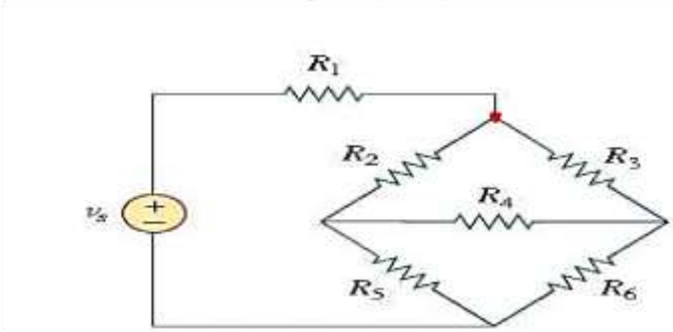

Figure 15-2: The bridge network

In this circuit R1, R2, R3, R4, R5, and R6 are neither in series nor in parallel

- the wye (Y) or tee (T) or star network shown in Figure (16- 2)

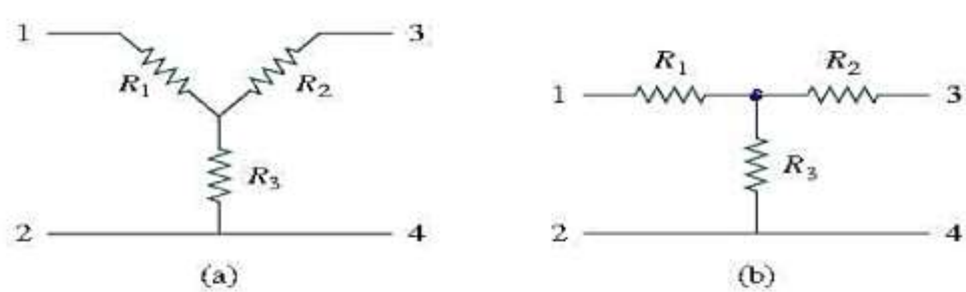

Figure 16-2 : (a) wye (Y), (b) tee (T)

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2.6.1 Delta to Wye Conversion

In this case transfer the(△) to (Y) connection , let consider the the circuit shown in the figure (18-2) that is help us to understand the transfer process

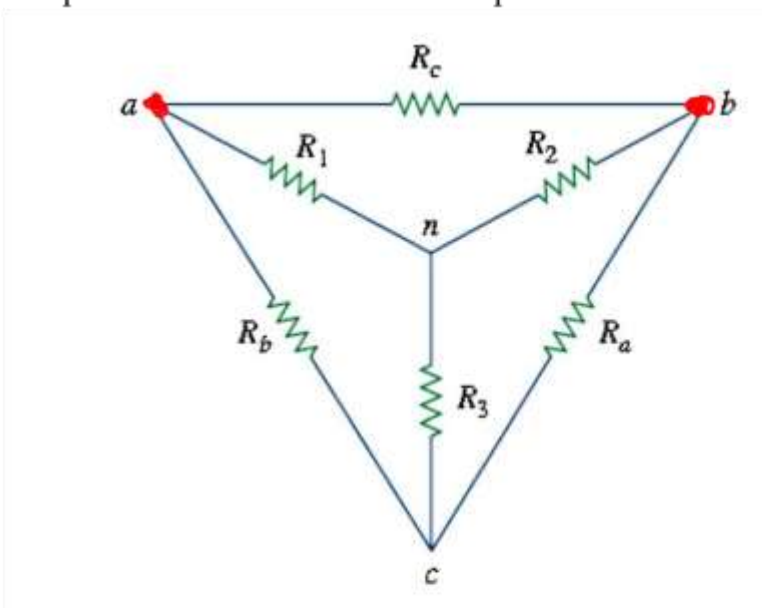

figure (18-2) : Delta to Wye Conversion

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$$R_1 = \frac{R_b R_c}{R_a + R_b + R_c}$$

$$R_2 = \frac{R_c R_a}{R_a + R_b + R_c}$$

$$R_3 = \frac{R_a R_b}{R_a + R_b + R_c}$$

2.6.2 Wye to Delta Conversion

In this case transfer the(Y) to (△) connection , let consider the same circuit shown in the figure (18-2) that is help us to understand laws of the transformation

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$$R_a = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_1}$$

$$R_b = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_2}$$

$$R_c = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_3}$$

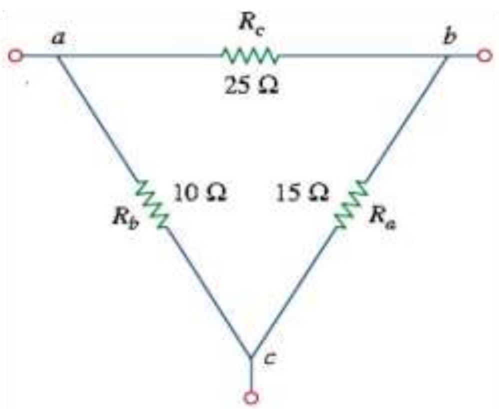
If the all value of the resistances are balanced thus,

$R_1=R_2=R_3=R_Y \qquad R_A=R_B=R_C=R_\Delta$

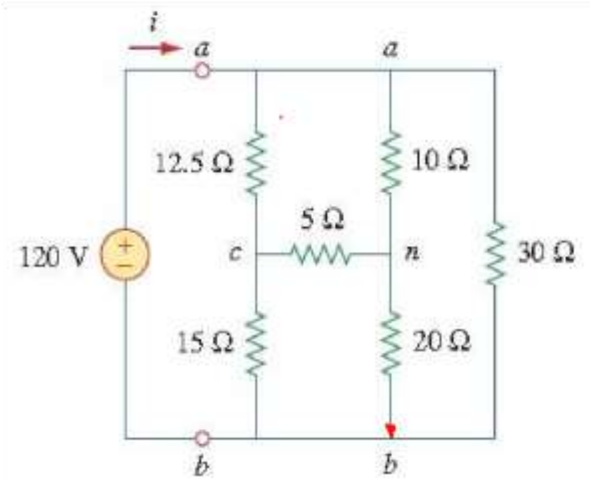
Under these conditions, conversion formulas become

$$R_Y = \frac{R_\Delta}{3} \qquad \text{or} \qquad R_\Delta = 3R_Y$$

Example : Convert the △ network in Figure shown below to an equivalent Y network



Example: - Obtain the equivalent resistance R_{ab} for the circuit in Figure shown below and use it to find current i.



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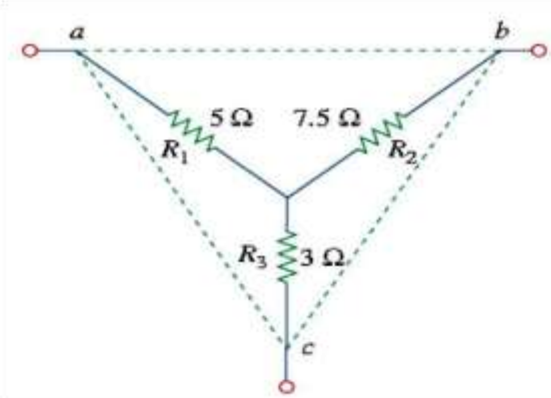
Solution :- start to draw the Y- connection as shown below , and apply the (△to Y) laws



$$R_1 = \frac{R_b R_c}{R_a + R_b + R_c} = \frac{10 \times 25}{15 + 10 + 25} = \frac{250}{50} = 5\ \Omega$$

$$R_2 = \frac{R_c R_a}{R_a + R_b + R_c} = \frac{25 \times 15}{50} = 7.5\ \Omega$$

$$R_3 = \frac{R_a R_b}{R_a + R_b + R_c} = \frac{15 \times 10}{50} = 3\ \Omega$$

The equivalent Y network is shown in Figure that shown above

Solution :- In this circuit, there are two Y networks and three △ networks. Transforming just one of these will simplify the circuit. If we convert the Y network comprising the 5Ω, 10Ω and 20Ω resistors, we may select

$$R_1 = 10\ \Omega, \qquad R_2 = 20\ \Omega, \qquad R_3 = 5\ \Omega$$

Star delta connection: Formula with example

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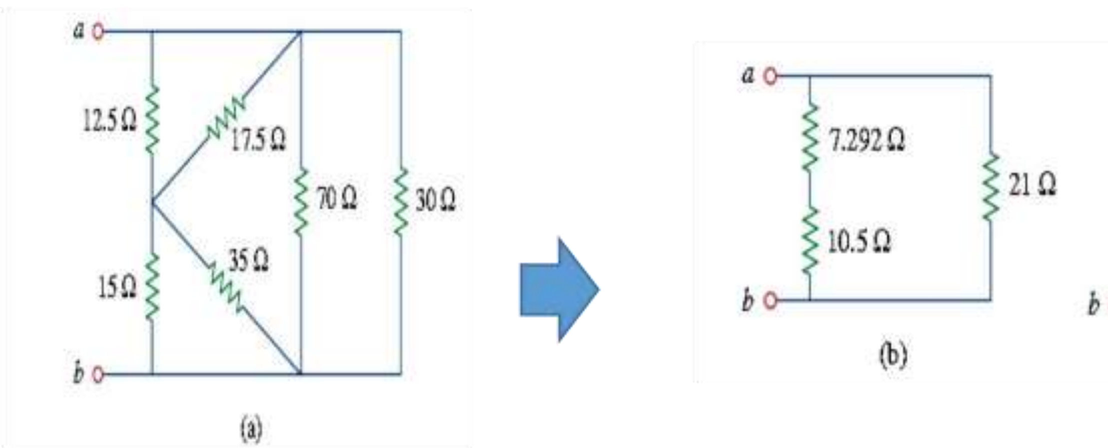
$$R_a = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_1} = \frac{10 \times 20 + 20 \times 5 + 5 \times 10}{10}$$
$$= \frac{350}{10} = 35\ \Omega$$
$$R_b = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_2} = \frac{350}{20} = 17.5\ \Omega$$
$$R_c = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_3} = \frac{350}{5} = 70\ \Omega$$

Thus the result of transfer (Y to △) will be as shown in figure (a) and simplify it to be as shown in figure (b)



The process of the simplify is

$$70 \parallel 30 = \frac{70 \times 30}{70 + 30} = 21\ \Omega$$
$$12.5 \parallel 17.5 = \frac{12.5 \times 17.5}{12.5 + 17.5} = 7.292\ \Omega$$
$$15 \parallel 35 = \frac{15 \times 35}{15 + 35} = 10.5\ \Omega$$

Hence, we find

$$R_{ab} = (7.292 + 10.5) \parallel 21 = \frac{17.792 \times 21}{17.792 + 21} = \mathbf{9.632\ \Omega}$$

Then

$$i = \frac{v_s}{R_{ab}} = \frac{120}{9.632} = \mathbf{12.458\ A}$$

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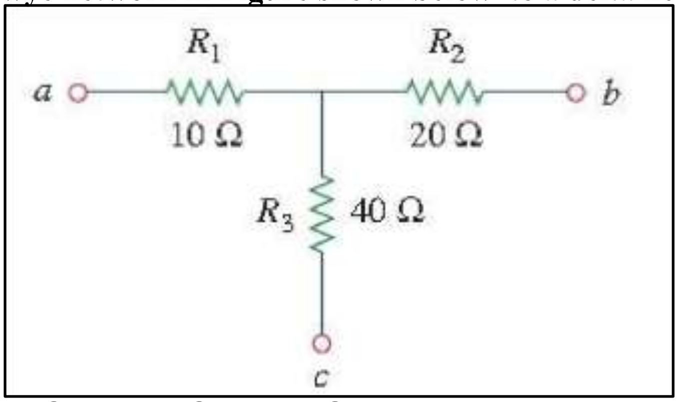
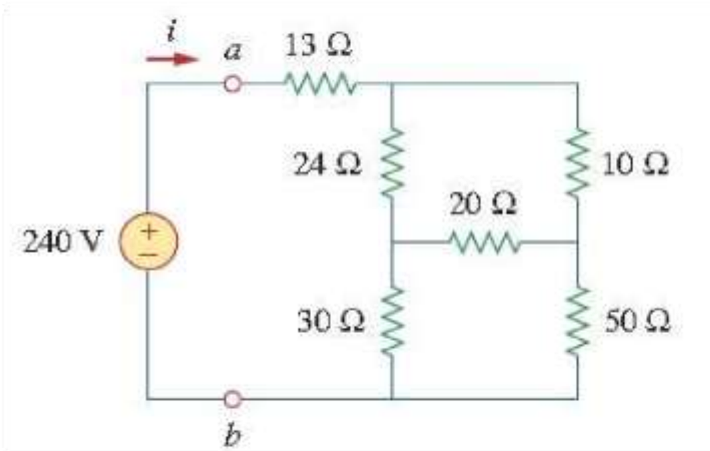
Home work:

- **Transform the wye network in Figure shown below to a delta network**



Answer: R_a =140 Ω, R_b = 70 Ω, R_c =35 Ω

- **Obtain the equivalent resistance R_{ab} for the circuit in Figure shown below and use it to find current *i*.**



Answer : 40 Ω, 6 A.

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