ELEMENTS OF ELECTRICAL ENGINEERING
Course Code : UE25EE141A/B

PES UNIVERSITY

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ELEMENTS OF ELECTRICAL ENGINEERING

Concept of ideal sources,
Voltage and Current Division Rules

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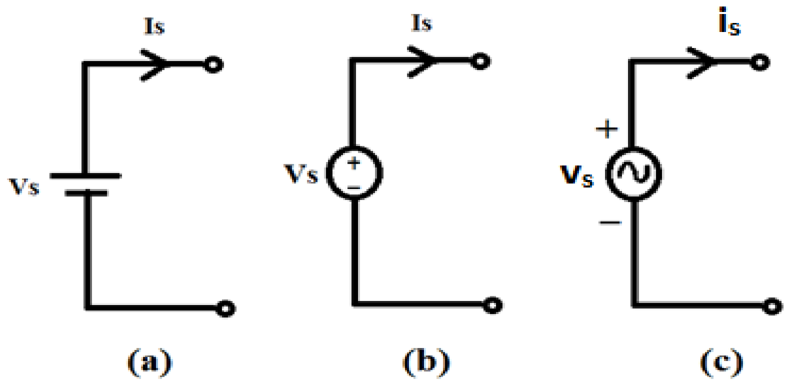
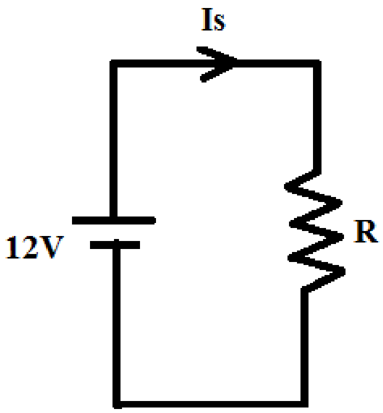
Ideal Voltage Source

Its terminal voltage is independent of current flowing through it.



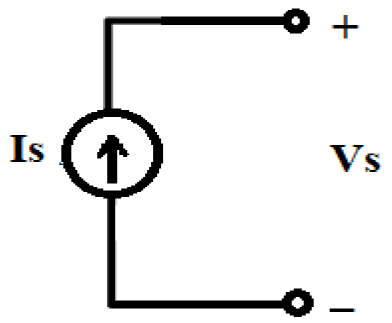
The current delivered by it depends on the circuit to which it is connected.



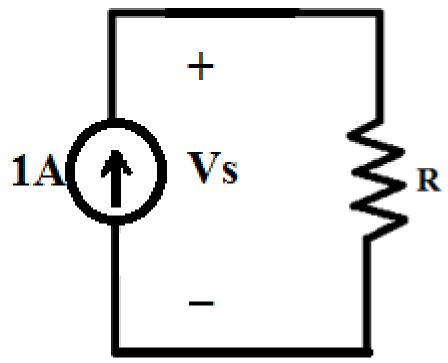
When R = 10Ω, I_S = 1.2A

When R = 1Ω, I_S = 12A

Ideal Current Source



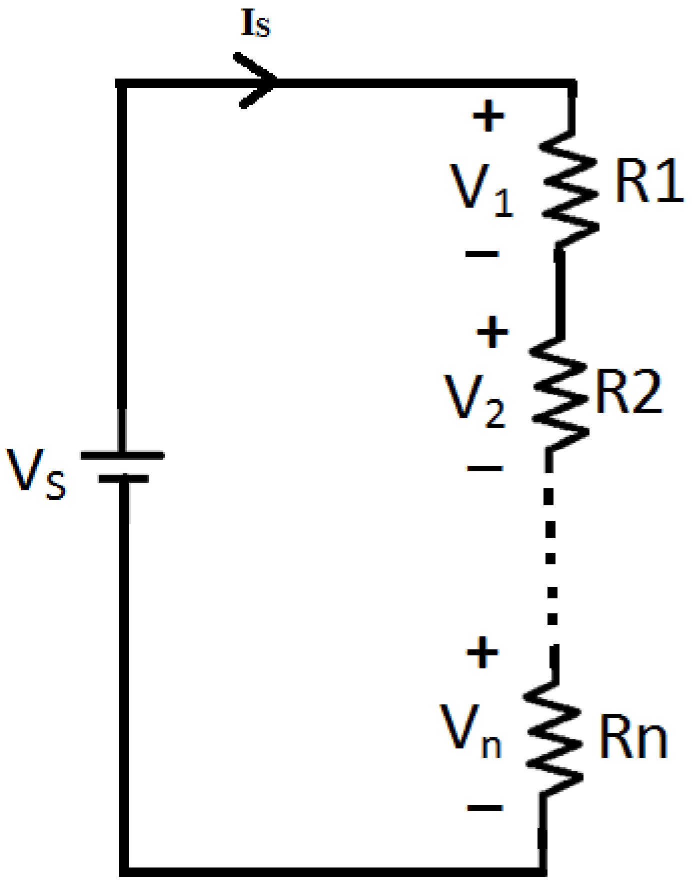
The voltage across it depends on the circuit to which it is connected.



When R = 1Ω, V_S = 1V
When R = 10Ω, V_S = 10V

Voltage Division Rule

It is applicable to Series Networks



$V_1 = I_S * R_1$

$V_2 = I_S * R_2$

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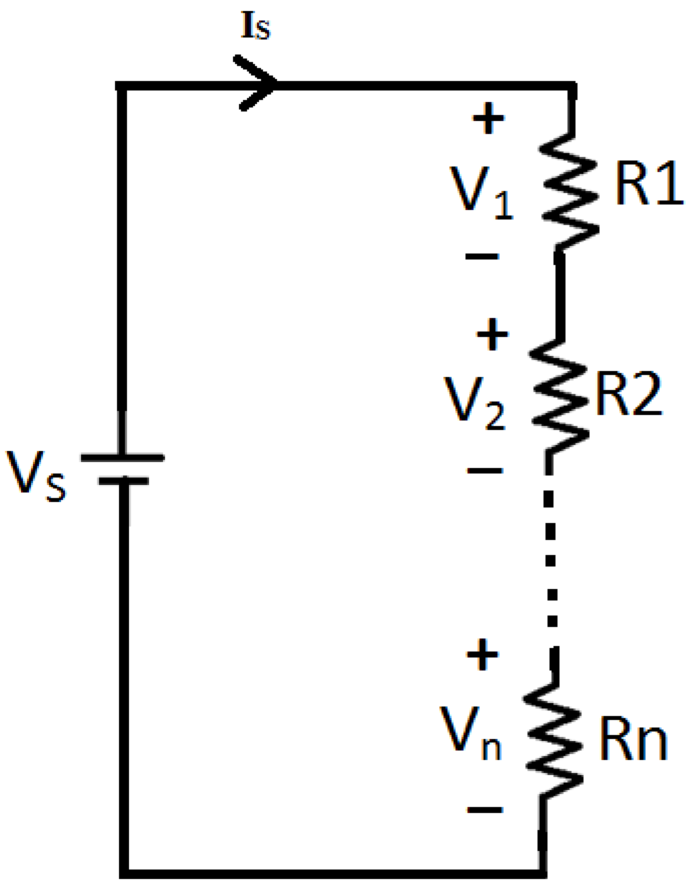
$V_n = I_S * R_n$

By KVL,

$V_S = V_1 + V_2 + \ldots + V_n$

Voltage Division Rule



Hence, $I_S = \frac{V_S}{(R_1+R_2+\cdots+R_n)}$

Therefore,

$$V_1 = \frac{V_S * R_1}{(R_1+R_2+\cdots+R_n)}$$

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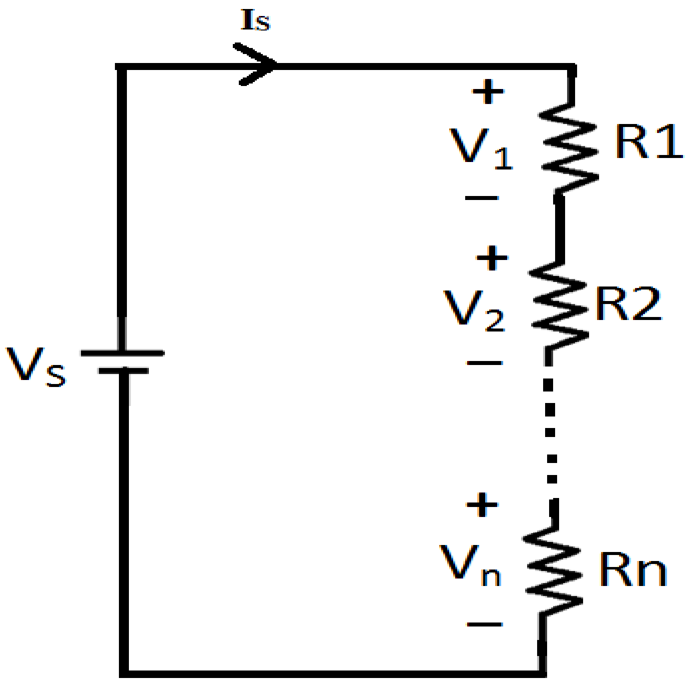
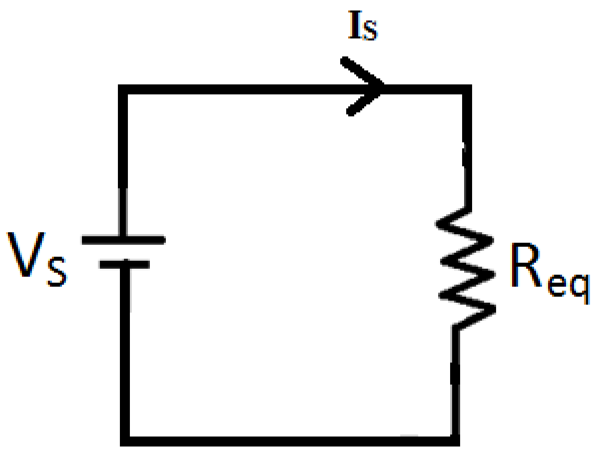
$$V_n = \frac{V_S * R_n}{(R_1+R_2+\cdots+R_n)}$$

Equivalent Series Resistance





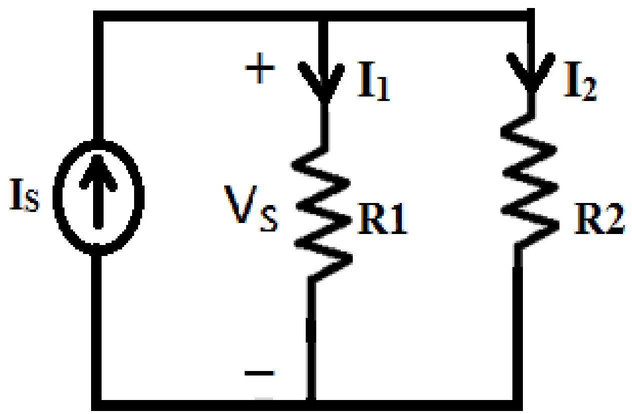
$$I_S = \frac{V_S}{R_{eq}}$$

$$I_S = \frac{V_S}{(R_1+R_2+\cdots+R_n)}$$

$$\boxed{R_{eq} = R_1+R_2+\ldots+R_n}$$

Current Division Rule

It is applicable to Parallel Networks



$I_1 = \frac{V_S}{R_1}$

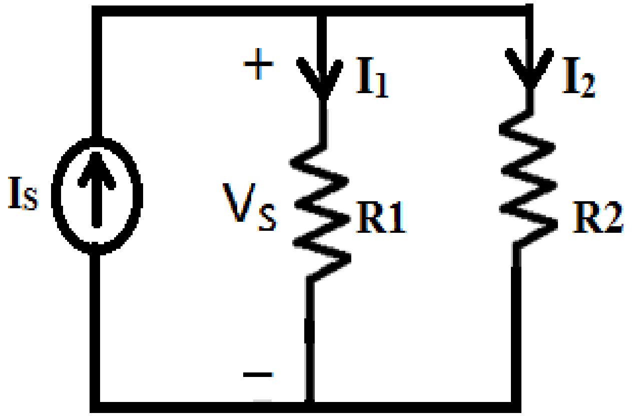
$I_2 = \frac{V_S}{R_2}$

By KCL,

$I_S = I_1 + I_2$

$I_S = V_S * (\frac{1}{R_1} + \frac{1}{R_2})$

Current Division Rule

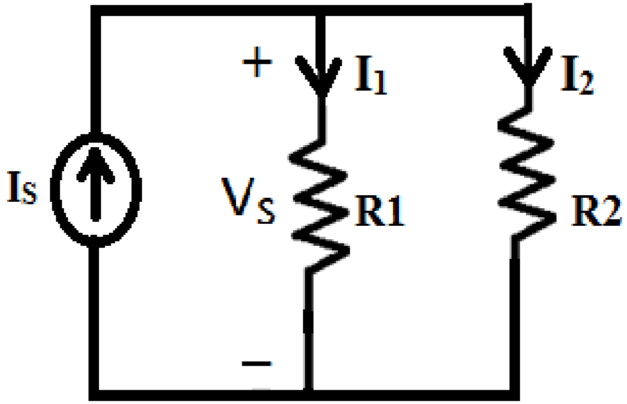


$$V_S = I_S * \frac{R_1 * R_2}{(R_1 + R_2)}$$

$$I_1 = I_s * \frac{R_2}{(R_1 + R_2)}$$

$$I_2 = I_s * \frac{R_1}{(R_1 + R_2)}$$

Equivalent Parallel Resistance

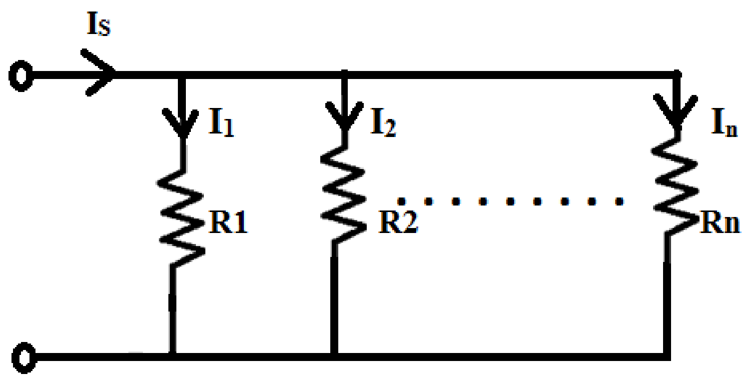


$$\frac{V_S}{I_S} = R_{eq} = \left(\frac{1}{R_1} + \frac{1}{R_2}\right)^{-1} = \frac{R_1 * R_2}{(R_1 + R_2)}$$

In general, For n Resistors in Parallel,

$$\frac{1}{R_{eq}} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_n}\right)$$

Current Division Rule – More than two resistors in Parallel



- Obtain R_{eq} using

$$\frac{1}{R_{eq}} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_n}\right)$$

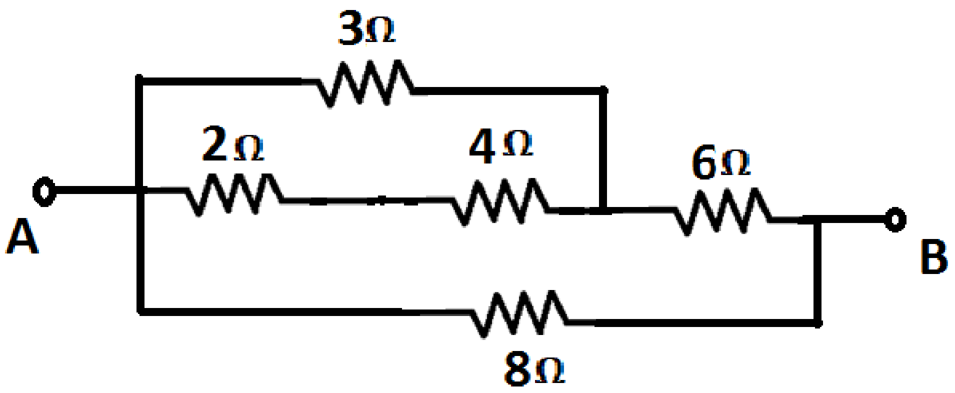
- Find V using

$V = I_S * R_{eq}$

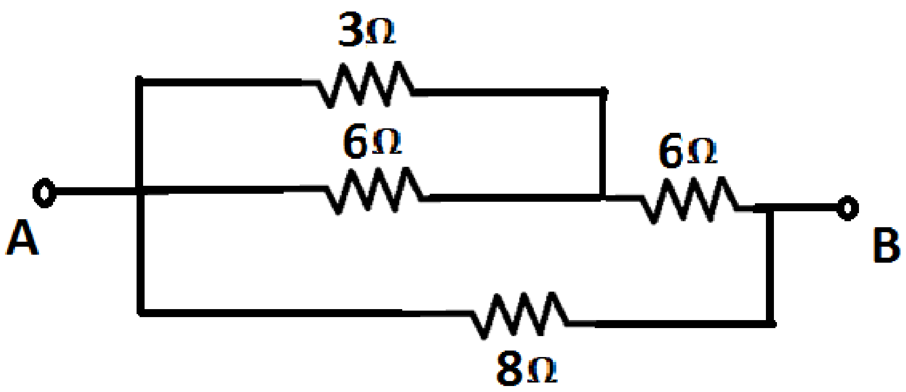
- Use Ohm's Law to find branch currents

Numerical Example – Finding Equivalent Resistance

Find the equivalent resistance between A & B

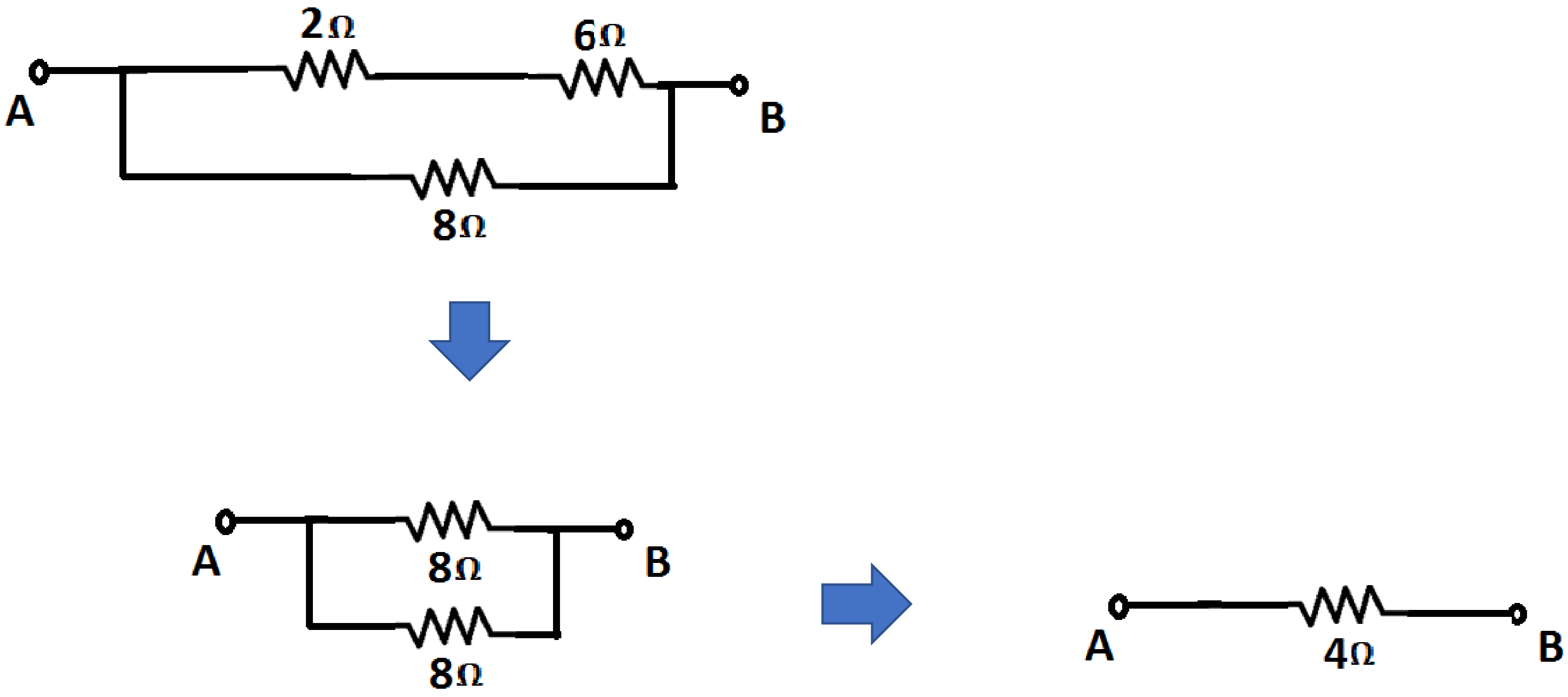


Solution:



Numerical Example – Finding Equivalent Resistance

Solution: (Continued..)



Text Book & References

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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