Vision

To be the centre of excellence in the field of technical education.

Program Code:- First Semester – All Program

Course Name:- Basic Science (PHYSICS)

Course Code : - BSC (22102)

Course coordinator: Mr. S. K. Rawat

Course Name:- Basic Science (PHYSICS)

Unit No:2

Unit Name: Laws of series and parallel combination.

Unit Outcomes (UO2d): Apply the principles of electricity and magnetism to solve engineering problems..

Learning Outcomes (LOs):

LO7: Student will be able to apply laws of series and parallel combination of resistance in the given electric circuits.

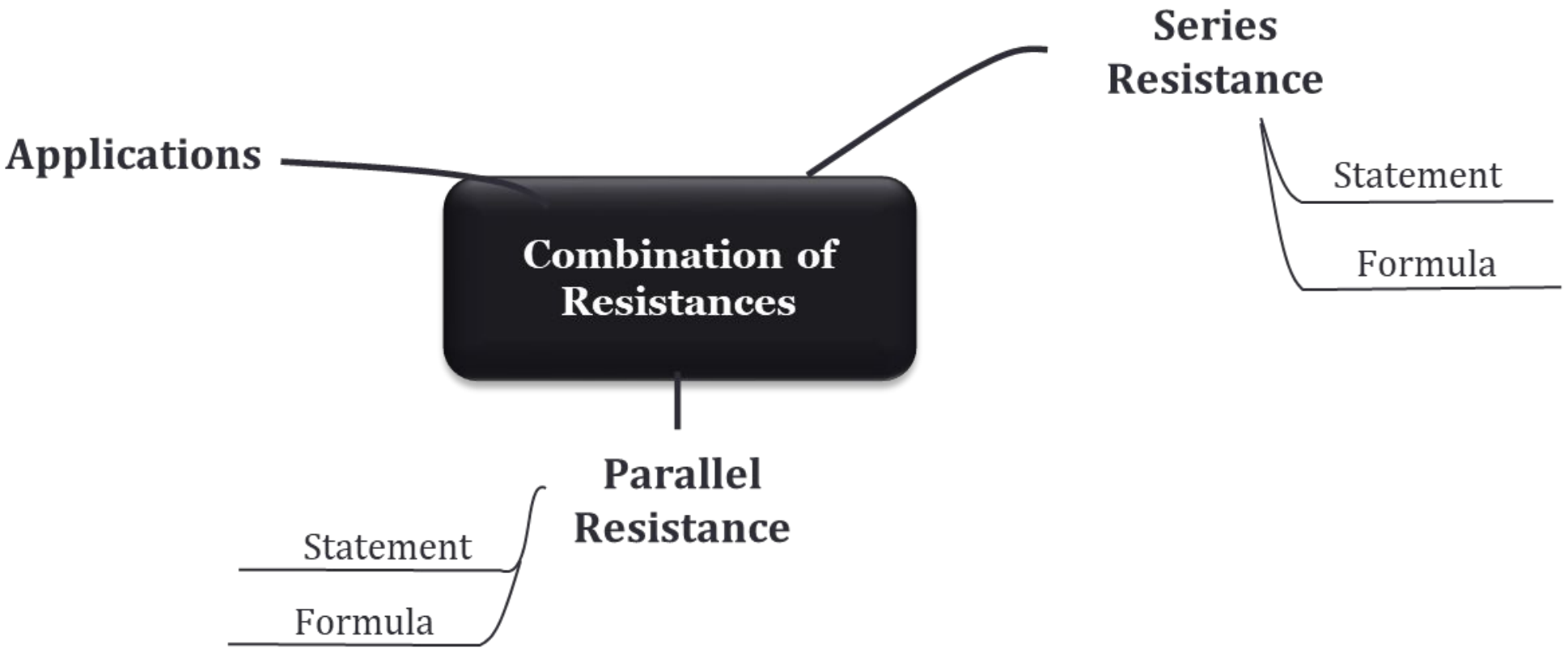
CONTENT

- Series combination
- Parallel combination
- Application

LEARNING OBJECTIVES

- Student will be able to apply laws of series and parallel combination of resistance in the given electric circuits.

Concept Map


Series Resistance
Statement
Formula
Applications
Combination of Resistances
Parallel Resistance
Statement
Formula

Combination of Resistance

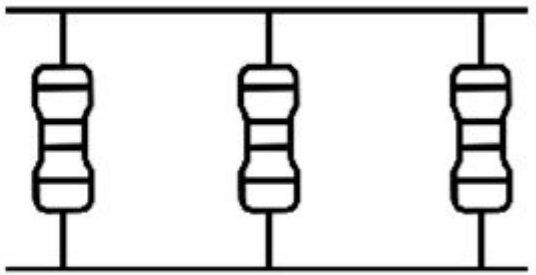
Resistors (Resistance) can be joined to each other by two ways:

1. Series combination
2. Parallel combination

SERIES CIRCUIT

$R_T = R_1 + R_2 + R_3 + \ldots R_n$

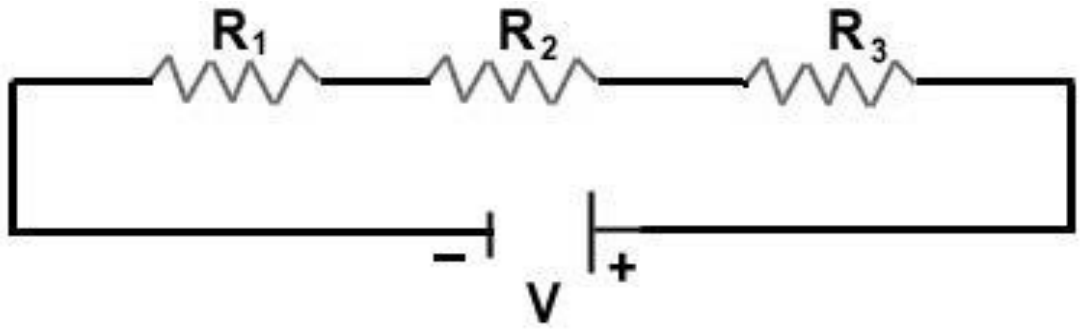
PARALLEL CIRCUIT



$1/R_T = 1/R_1 + 1/R_2 + 1/R_3 \ldots 1/R_n$

Series Combination

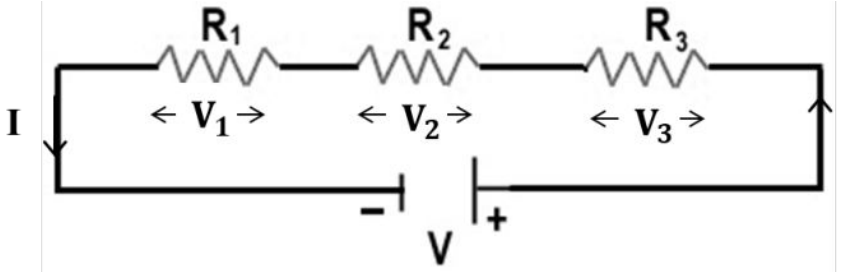
- If different resistances are joined with each other such that there is only one path for the flow of electric current then the combination of such resistances is called Series Combination.
- In series combination current through each resistor is constant.
- In series combination potential difference across each resistor is different depending upon the value of resistance.
- Equivalent resistance of circuit is equal to the sum of individual resistances. i.e., $\mathbf{R_S = R_1 + R_2 + R_3}$



Series Combination

Mathematical Derivation:

- Consider three resistances R1, R2, & R3 connected in series combination with a power supply of voltage V.
- Let electric current I is passing through the circuit.
- Potential difference of each resistor is V_1, V_2, & V_3 respectively.
- Now $\mathbf{V = V_1 + V_2 + V_3}$
- According to Ohms Law, $\mathbf{V = IR}$
- Therefore $\mathbf{IR = IR_1 + IR_2 + IR_3} \rightarrow$ $\mathbf{IR = I(R_1 + R_2 + R_3)}$
- Thus $\mathbf{R = R_1 + R_2 + R_3}$



Attempt Set 1 MCQs

Question No	Question No. 1	Question No. 2	Question No. 3
Statement of Question	When cells are connected in series, we get _____	When number of resistances are connected in _____ combination, its equivalent resistance increases.	Combined resistance of 5 Ω and 10 Ω is equal to
Level of Question	Applications	Understanding	Applications
Option (a)	a) Dynamo	a) series	a) 10 Ω
Option (b)	b) Generator	b) parallel	b) 16 Ω
Option (c)	c) Battery	c) parallel and series	c) 15 Ω
Option (d)	d) None of the above	d) none of the above	d) 20 Ω
Correct Option	**Battery**	**series**	**15 Ω**

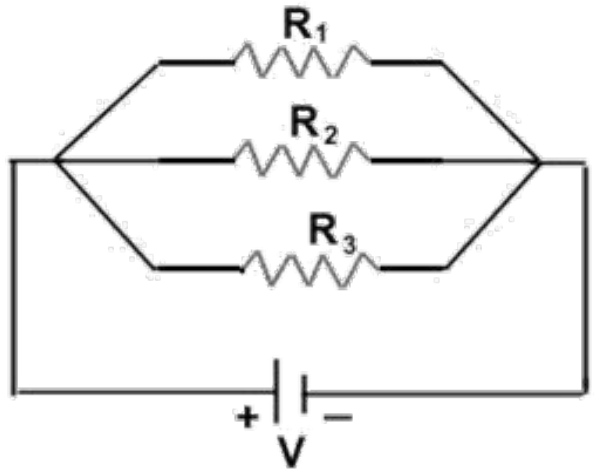
START

Parallel Combination

- If there is more than one path for the flow of current in a circuit then the combination of resistances is called Parallel Combination.
- In parallel combination current through each resistor is different.

- Potential difference across each resistor is constant.
- Equivalent resistance of circuit is always less than either of the resistances included in the circuit.
- The reciprocal of equivalent resistance of circuit is equal to the sum of the reciprocal of the individual resistances in the circuit.

i.e., $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$



Series Combination

Mathematical Derivation:

Consider three resistances R_1, R_2, & R_3 connected in parallel combination with a power supply of voltage V.

Let electric current I is passing through the circuit.

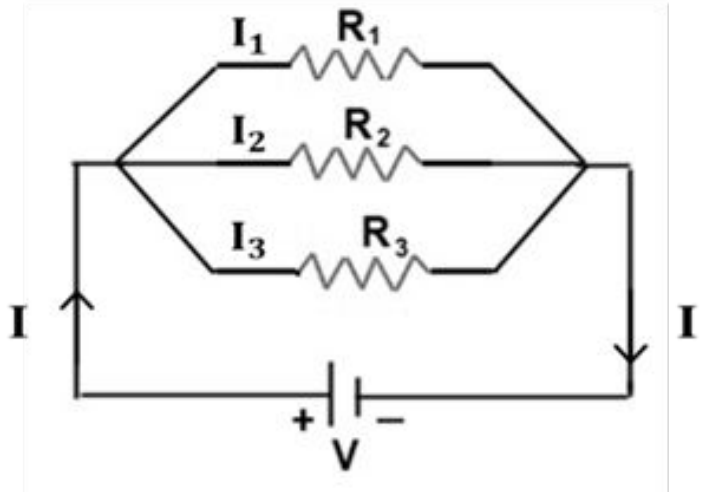
Current through each resistor is I_1, I_2, & I_3 respectively.

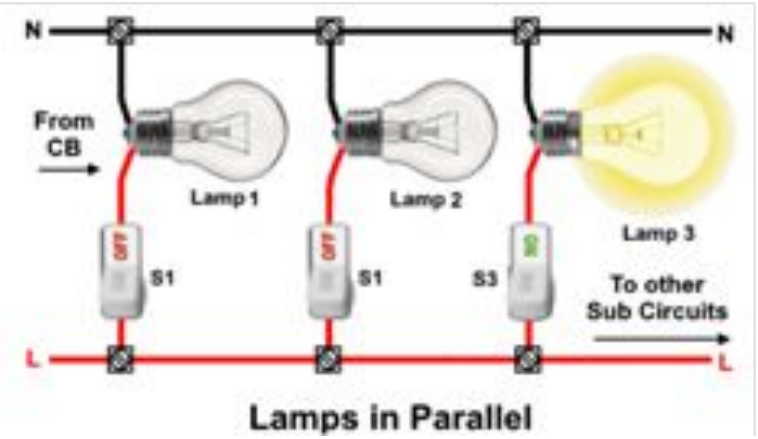
Now $\mathbf{I = I_1 + I_2 + I_3}$ and according to Ohms law, $\mathbf{I = \frac{V}{R}}$

Therefore $\mathbf{\frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}} \rightarrow$

$$V\left(\frac{1}{R}\right) = V\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)$$

Thus $\mathbf{\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$



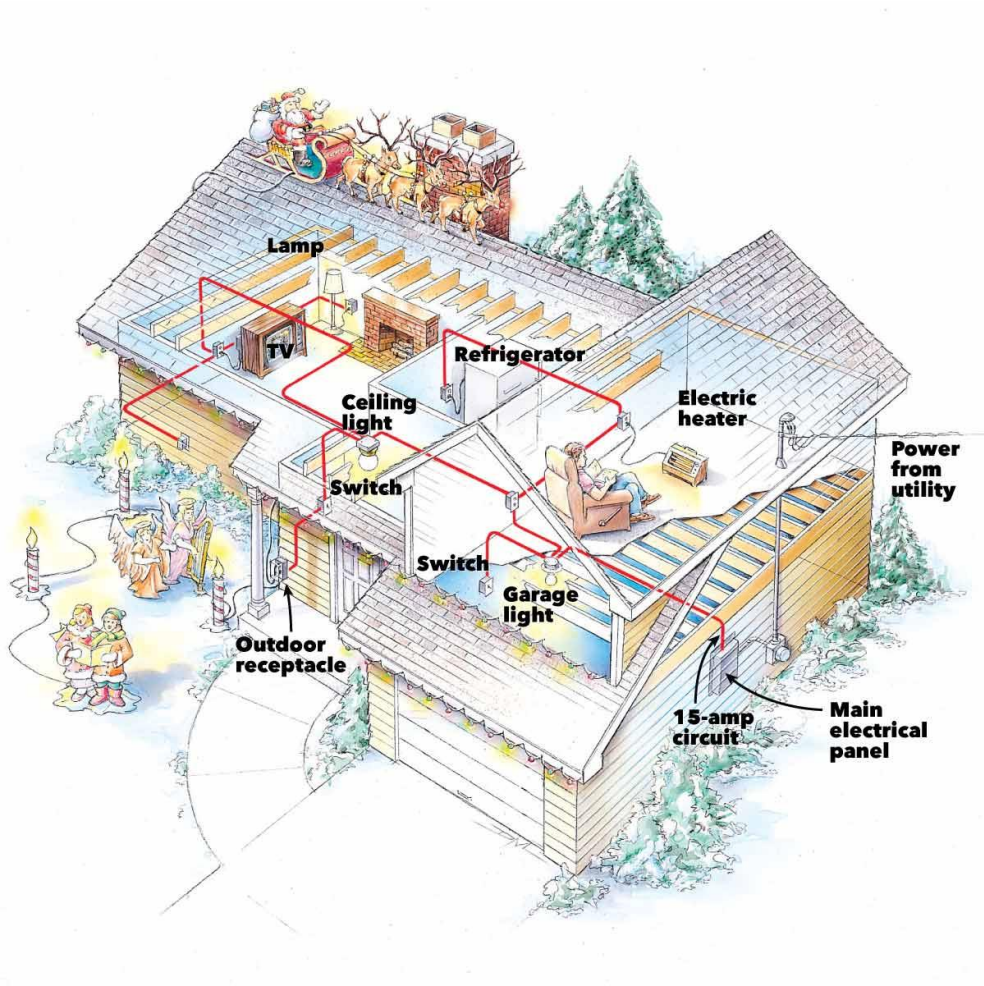


Lamps in Parallel

Applications

Series combination

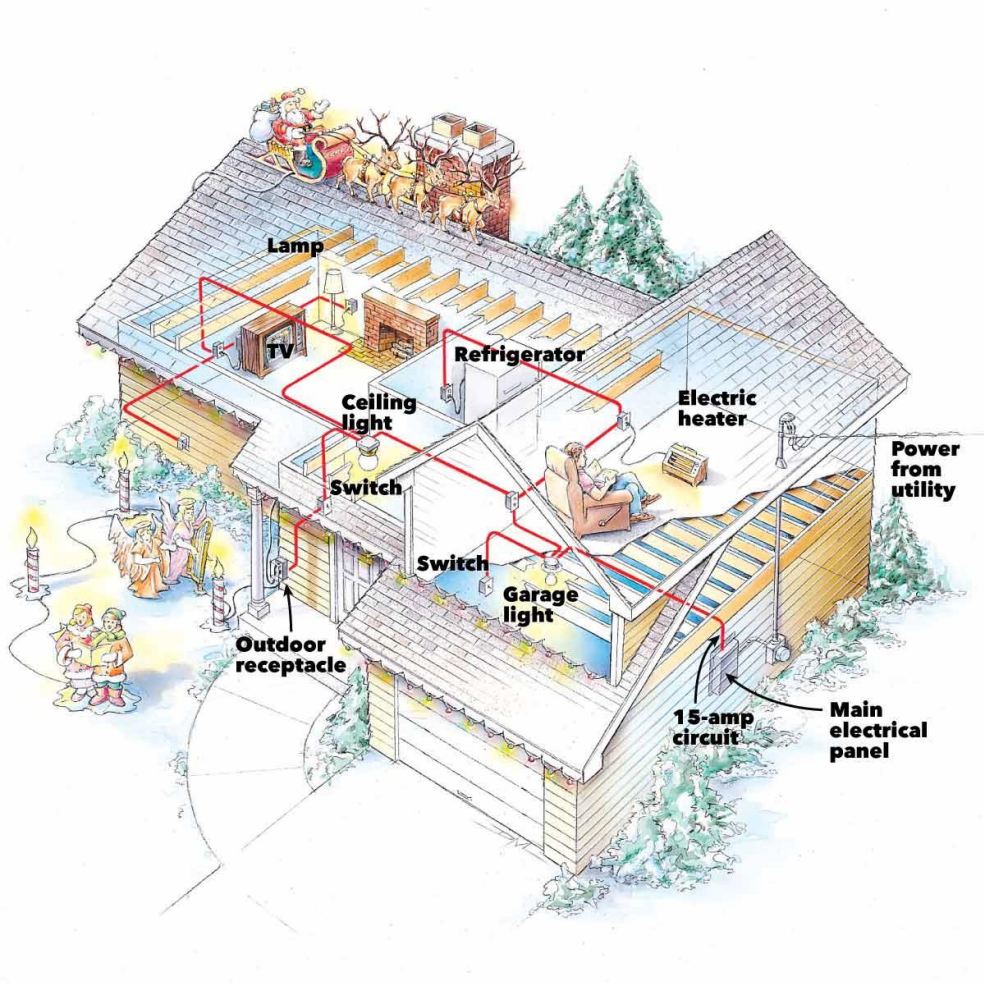
- Series circuit connections are common and greatly employed in electrical equipment's.
- The tube filaments in small radios are usually in series.
- Current controlling devices are always connected in series with the device that they protect.
- Fuses are connected in series with the device they protect
- Automatic house-heating equipment has a thermostat, electromagnetic coils, and safety cut-outs connected in series with a voltage source etc.



Applications

Parallel combination

- Parallel circuit connection is very common in use.
- Various lamps and electrical appliances in our homes are connected in parallel so that each of the lamps or bobs and appliances can be operated independently.
- For us to have control over the individual lamps or loads, they have to be wired in parallel.



Attempt Set 2 MCQs

Question No	Question No. 1	Question No. 2	Question No. 3
Statement of Question	When number of resistances are connected in _____ combination, its equivalent resistance decreases.	In parallel combination voltage passing through each resistor is	The effect of connecting an additional parallel load to an electrical supply source is to increase the:
Level of Question	Remembering	Remembering	Understanding
Option (a)	a) series	a) same	a) resistance of the load
Option (b)	b) parallel	b) Different	b) voltage of the source
Option (c)	c) parallel and series	c) low voltage	c) current taken from the source
Option (d)	d) none of the above	d) high voltage	d) p.d. across the load
Correct Option	**parallel**	**same**	**current taken from the source**

START