Lecture (2)

Electricity AC and DC

Electrical Current:

The continuous flow of free electronic constitutes an electric current. The unit of current is ampere (A) and is measured by Ammeter. It is denoted by the letter "I".

Ampere:

If one coulomb charge cross over the area of cross section of the conductor per one second then the value of current flows through the conductor is called 'one Ampere'.

Voltage:

To create the current flow in a conductor; the electrical pressure which is used to move the electrons is called voltage. It is denoted by the letter 'V'. the unit of voltage is 'volt' and is measured by voltmeter.

Resistance:

The property of conductor which opposes the flow of current through it is called resistance. It is denoted by the letter 'R'. the unit of resistance is ohms (Ω) and it is measured by Ohm meter.

Ohm:

When a conductor having 1V potential between the two end points; one ampere current will flowing through the conductor and the resistance value of the conductor is 1 Ohm (Ω).

Electric Power:

Power is defined as the product of voltage and current. Unit of power is watts and denoted by the letter "P".

The electrical unit

Quantity	Symbol	Unit	Abbreviation
Current	I	Ampere	A
Voltage	V	volt	V
Resistance	R	Ohm	Ω
Charge	Q	Coulomb	C
Power	P	watt	W

Engineering prefix:

Multiplier	Prefix	Symbol
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10	deka	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

Example-1 Express the following in engineering prefix:

a) 10×10^4 volt. b) 0.1×10^{-3} watts. C) 250×10^{-7} ampere

Solution:

a) $10 \times 10^4\ Volt = 100 \times 10^3$V = 100 kV.
b) $0.1\times 10^{-3}\ Watts = 0.1\ miliwatt = 0.1mW$
c) $250\times 10^{-7} ampere = 25 \times 10^{-6} A = 25\mu A$

Example-2 Convert 0.1MV to kV

Solution

$0.1 \times 10^6 V = (0.1 \times 10^3) \times 10^3 = 100KV$

Homework: Convert 1800kV to MV

Law of resistance:

The resistance of a conductor in a circuit depends upon the following states

- It depends upon the material.
- Directly proportional to the length of the conductor.
- Inversely proportional to the area of the cross-section of the conductor.
- It also depends upon the temperature of the conductor.

Resistance calculation:

$$R = \rho \frac{L}{A}$$

Where:

R is the resistance (ohms)

ρ is specific resistance (resistivity) in (ohm. Meter).

L is length of the conductor (meter).

A is area of the cross section of a conductor (Sq.m).

Specific resistance:

The resistance that is offered by one cubic cm material is called specific resistance. The following table shows the specific resistance of material:

Materials		Specific resistance is ohm - meter
Gold	-	2.42×10^{-8}
Silver	-	1.63×10^{-8}
Copper	-	1.724×10^{-8}
Aluminium	-	2.83×10^{-8}
Rubber	-	8×10^{7}
Glass	-	10×10^{11}

Example-3: $1cm^2$ cross section 50m long copper conductor has specific resistance 1.72* $10^{-8}\Omega$.cm find the resistance.

Solution:

L=50m=50*100cm=5000cm

$$A=1cm^2$$

Specific resistance =$1.72\times 10^{-8}\Omega$..cm

$$R=\rho\frac{L}{A}$$

$$= 1.72\times 10^{-8} \times \frac{5000}{1} = 0.0086\Omega$$

Ohm's Law

A relationship was derived by the scientist Ohm; between the current; voltage and resistance of the circuit. It says;

"At a constant temperature; the current flowing through the circuit is directly proportional to the voltage and inversely proortional to the resistance".

$$\text{Current}=\frac{\text{voltage}}{\text{Resistance}}$$

$$\text{i.e. } I = \frac{V}{R}$$

$$R = \frac{V}{I}$$

$$V = I \times R$$

When the resistance of a circuit is constnt; if the voltage increases the current increases and the voltage degreases the current decreases. If any two of the three values (I; V; R) are known the third value can be easily calculated.

Example-4 The supply voltage of the circuit is 240V and the resistance value is 12 Ω. Calculate the current flowing through this circuit.

Solution:

Voltage (V) = 240V

Resistance (R) = 12Ω

Current (I) = ?

According to Ohm's law:

$$I=\frac{V}{R} = \frac{240}{12} = 20A$$

Example-5 The supply voltage of the circuit is 230V. if 10A current is flowing through this circuit. Calculate the resistance value of the circuit.

Solution:

Voltage (V) = 230v

Current (I) = 10A

Resistance (R) = ?

According to Ohm's law

R=$\frac{V}{I}$

R=$\frac{230\ V}{10\ A}$

R=23 Ω

Homework : Find out the voltage of the circuit when 6A current is Homework flowing through the circuit. Resistance of the circuit is 40Ω.