POWER

Subject Name: Electrical Fundamentals

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INDEX

Sr. No.	Topic
a	POWER , WORK AND ENERGY (KINETIC/POTENTIAL)
b	DISSIPATION OF POWER BY A RESISTOR
c	POWER FORMULA
d	CALCULATION OF INVOLVING POWER,WORK & ENERGY

POWER AND ENERGY

Power is defined as the rate of energy consumption or conversion within that system – that is, the amount of energy used or converted in a given amount of time.

$$P = \frac{\varepsilon}{t}$$

Where
P = Power measured in Watts (W)
& = Energy measured in Joules 0)
t = Time measured in Seconds (s)

The unit measurement for power is the watt (W), which refers to a rate of energy conversion of 1 joule/second.

Example:
300 J of energy is consumed in 10 seconds.
What would be the power in watts?

Solution:

Power = energy in Joules / time in seconds

P = 300 J / 10 sec

P = 30 watts

Power is the rate of doing work.
It is equivalent to the work divided by time.

Example
An electric motor rated as a 1 horsepower
motor requires 746 watts of electrical energy.

Conversion of Horse Power in Watts
1 Horse Power = 746 Watts

When current flows through a resistive circuit,
energy is dissipated in the form of heat.

$$E = \frac{W}{Q}$$

Where:
E = potential difference in volts
W = energy expanded or absorbed in joules (J)
Q = Charge measured in coulombs

Current I, can also be expressed in terms of charge and time as given by the expression:

Current = Charge / Time
$I = Q / t$
Where:
I = Current in Amperes (A)
Q = Charge in Coulombs (C)
t = time
Now ,

Power = E x I = (E / Q) X (Q / t) = E / t

Example: If a circuit has a known voltage of 24 volts and a current of 2 amps, then the power in the circuit will be
P = E x I = 24 x 2 = 48 watts.

Second Form of Power Equation

Power = $P = I^2 R$

Third Form of Power Equation

Power = $P = E^2 / R$
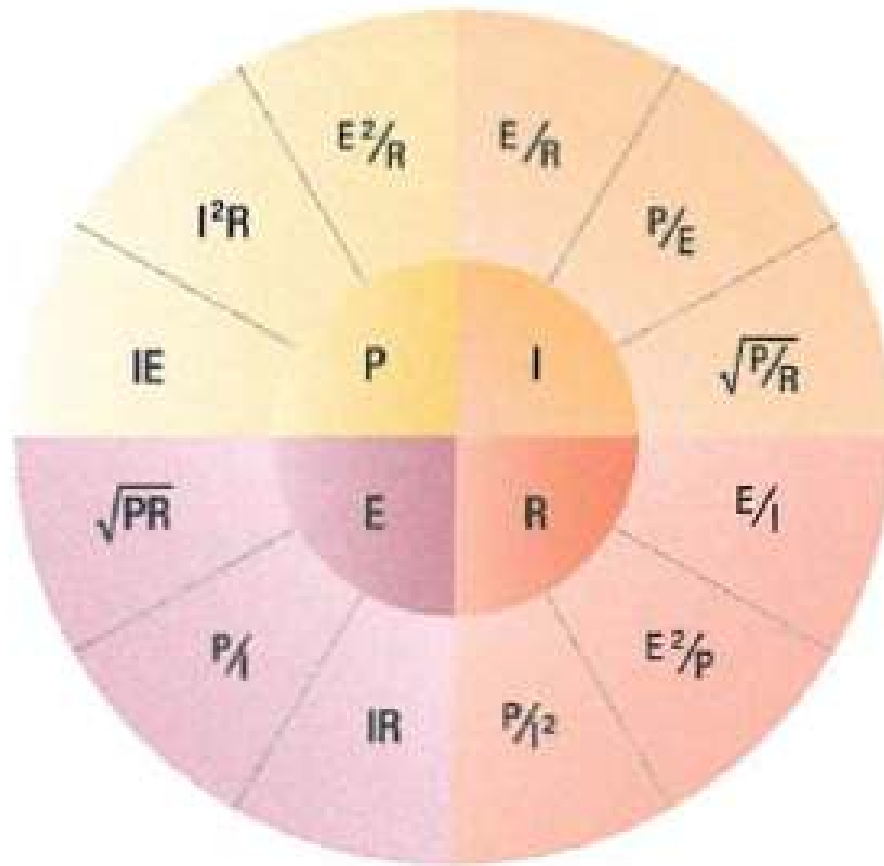
POWER IN A SERIES AND PARALLEL CIRCUIT

The total power dissipated in both a series and parallel circuit is equal to the sum of the power dissipated in each resistor in the circuit.

$P_T = P_1 + P_2 + P_3 + \bullet \bullet \bullet P_N$

Figure below provides a summary of all the possible transpositions of the Ohm's law formula and the power formula.

ENERGY IN AN ELECTRICAL CIRCUIT

Energy is defined as the ability to do work.
Power is the rate of energy usage.
Power used over a span of time is actually energy consumption.
Energy = Power multiplied time.
The joule is defined as a unit of energy.

Another unit of measure
Power is expressed in watts and time in seconds.
A unit of energy can be called a watt second (Ws) or a kilowatt hour (kWh).