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(An Autonomous Institution)

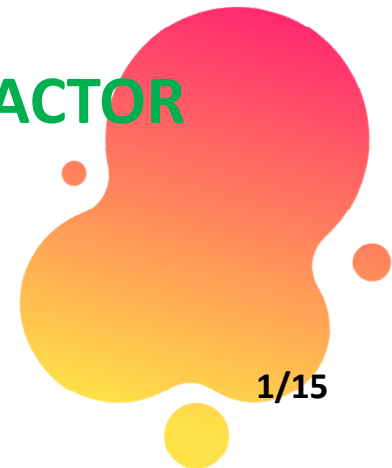
COIMBATORE-35

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23EET101 / BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING I YEAR / I SEMESTER UNIT-I: ELECTRICAL CIRCUITS AND MEASUREMENTS

AC FUNDAMENTALS, POWER & POWER FACTOR

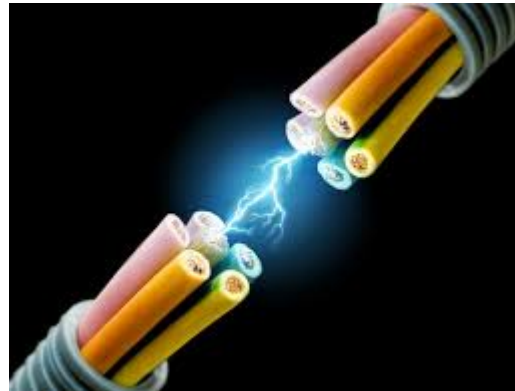


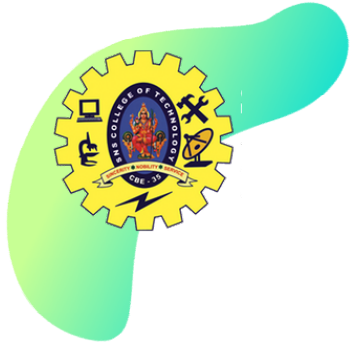


TOPIC OUTLINE



- AC fundamentals
 - Peak and RMS
 - Power
- Real and Reactive Power
 - Power factor



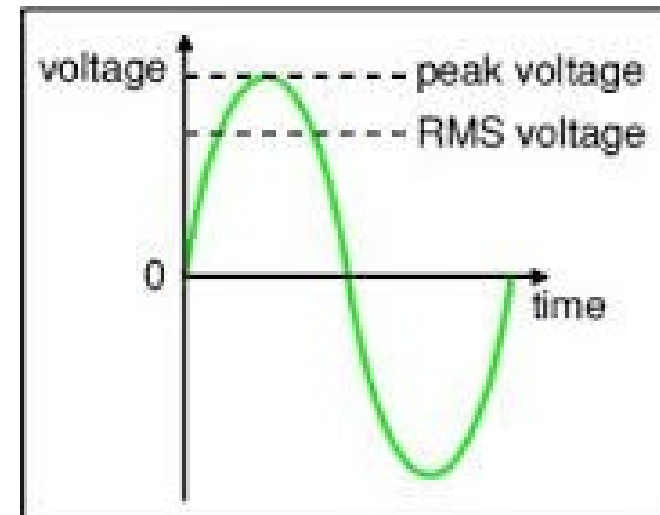


AC FUNDAMENTALS



PARAMETER VALUES:

- Instantaneous (v, i)
- Peak (V_m, I_m)
- Average (V_{ave}, I_{ave})
- RMS (V, I or V_{rms}, I_{rms})



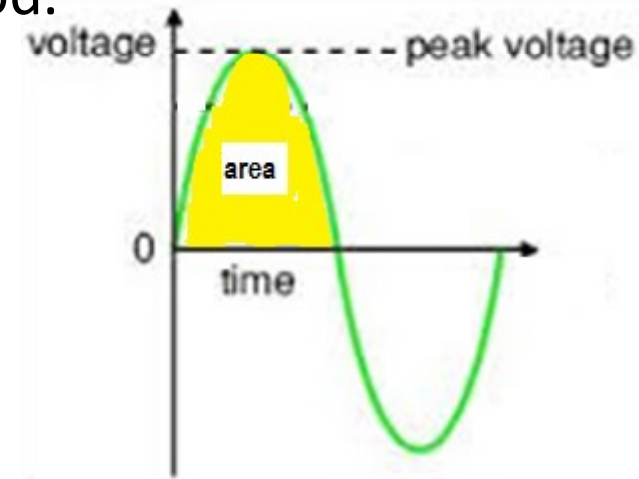
Parameters V and I are in sine wave.





AC FUNDAMENTALS

- **Peak (V_m, I_m)** : It is the maximum value
- **Instantaneous (v, i)** : The values at any instant. It may be voltage or current.
- **Average (V_{ave}, I_{ave})**: Average value is the sum of instantaneous power in one period.
- It is also said to be as area under the curve divided by time.
- Average power - for half cycle is shown
- - for full cycle is ZERO

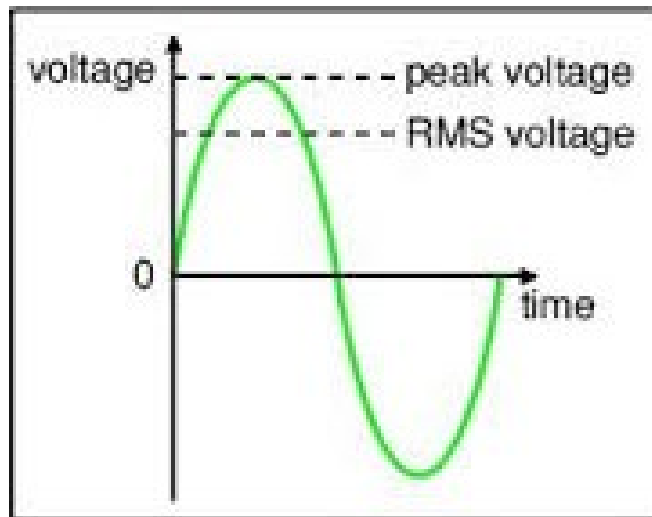




ROOT MEAN SQUARE (RMS)



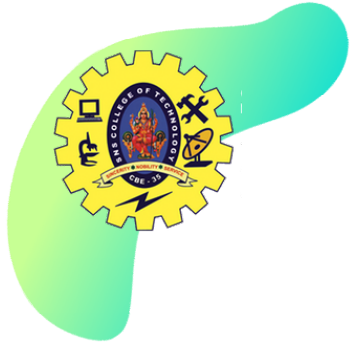
The RMS value of a set of values (or a continuous-time waveform) is the **square root** of the arithmetic mean of the squares of the original values.



$$rms = \frac{V_{peak}}{\sqrt{2}} \text{ (for an undistorted sine wave)}$$

$$rms = \frac{V_{peak}}{\sqrt{3}} \text{ (for an undistorted triangle wave)}$$

$$rms = \frac{V_{peak}}{1} \text{ (for a symmetrical square wave)}$$



RMS



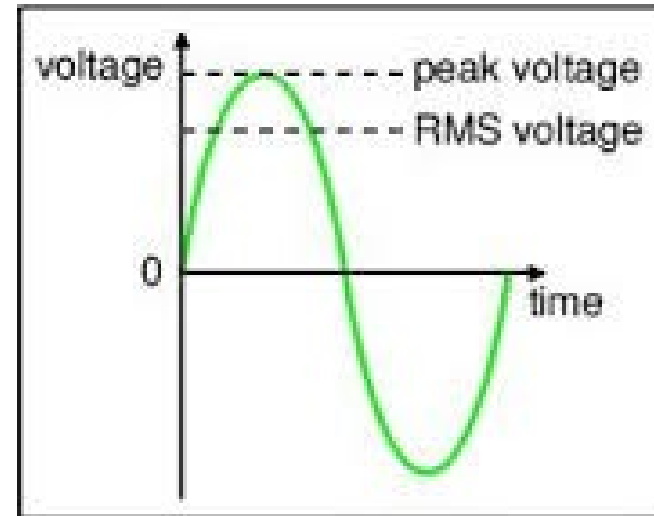
RMS value for I and V is given

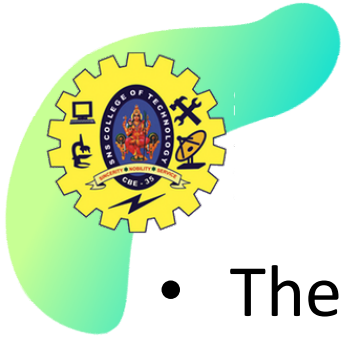
$$I = I_p \sin \omega t$$

$$V = V_p \sin \omega t$$

Where,

ωt = radians per second





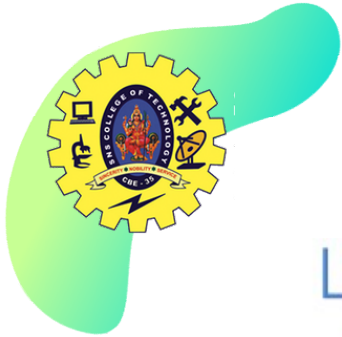
POWER

- The **power** dissipated in a component is a **product of** the instantaneous **voltage** and the instantaneous **current**

$$p = vi$$

- In a **resistive circuit** the voltage and current are in **phase** – calculation of **p** is straightforward
- In **reactive circuits**, there will normally be some phase **shift between v and i** , and calculating the power becomes more complicated

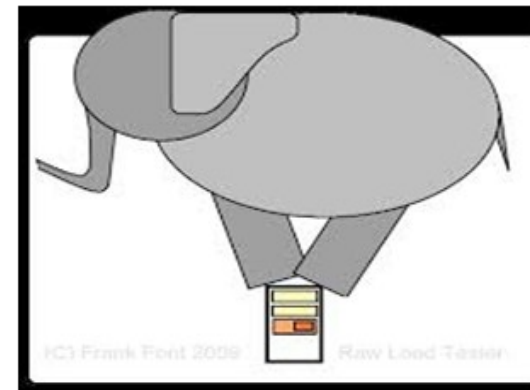
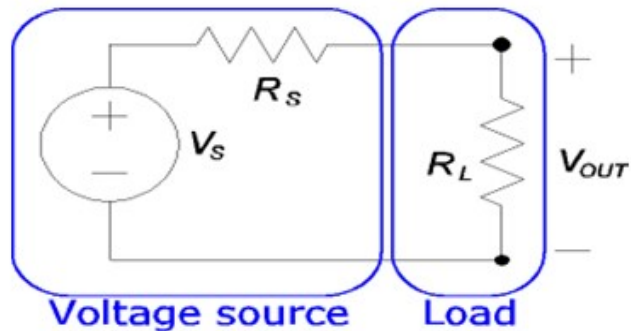




POWER

LOAD (POWER CONSUMED)

- It is a any electric load on a circuit that does work.
- A device connected to the **output of a circuit**
 - **Example:** Power windows, light bulbs, motors.



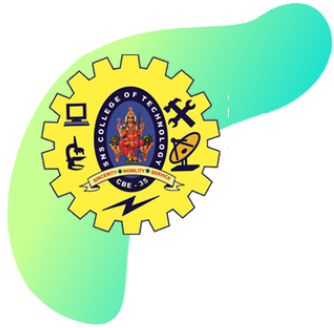


POWER



- **Real power** is the capacity of the circuit performing work in a particular time.
 - It is the product of V , I and cosine angle of voltage and current
- **Apparent power** is the product of the current and voltage of the circuit
- **Reactive power** is the product of V , I and sine angle of voltage and current



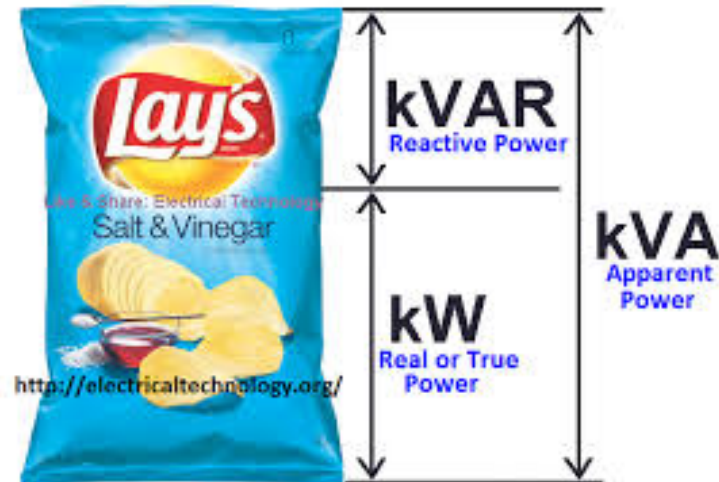


POWER



| | | |
|----------------|--------------------|-------------|
| Real Power | $P = VI \cos \phi$ | watts or kW |
| Reactive Power | $Q = VI \sin \phi$ | var or kVAR |
| Apparent Power | $S = VI$ | VA or kVA |

$$S^2 = P^2 + Q^2$$





REAL AND REACTIVE POWER

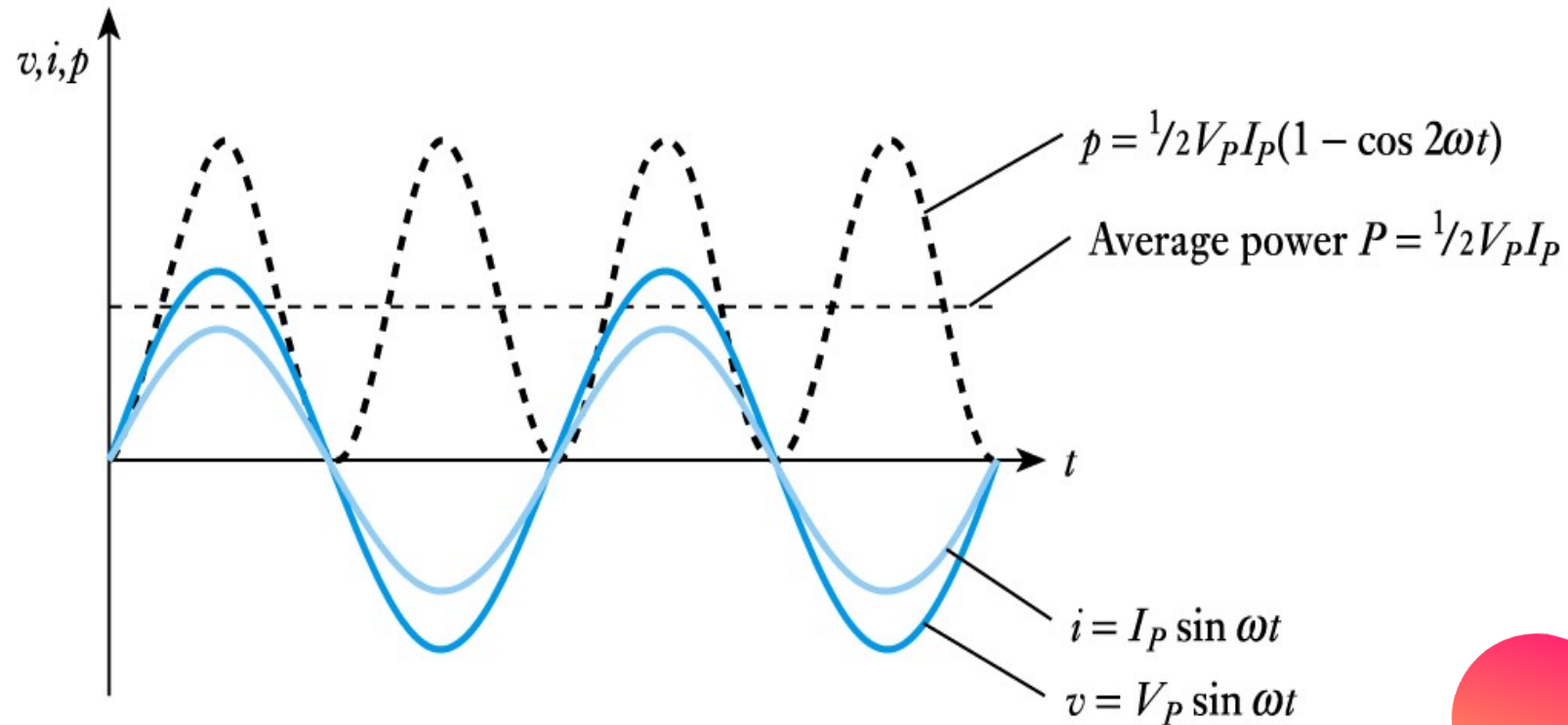


If a circuit has resistive and reactive parts, the resultant power has 2 parts:

- The first is *dissipated* in the resistive element. This is the **real power, P**
- The second is *stored and returned* by the reactive element. This is the **reactive power, Q** , which has units of **volt amperes reactive** or **var**



RELATIONSHIP BETWEEN V , I AND P IN A RESISTOR

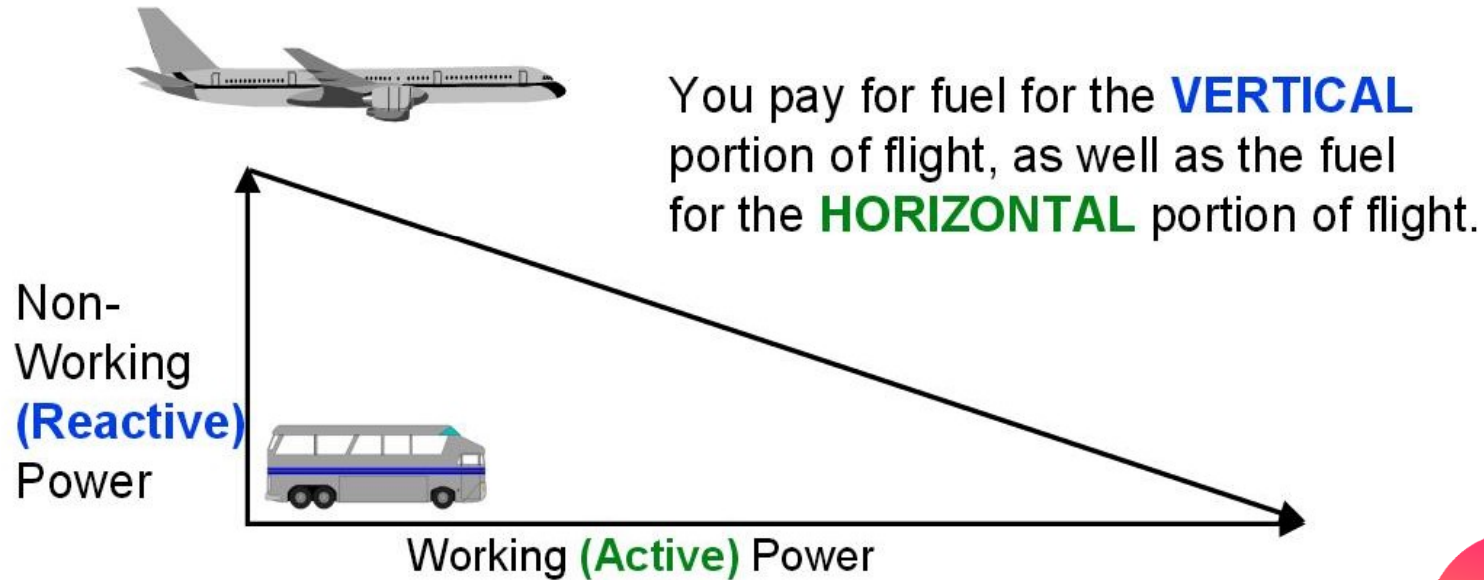


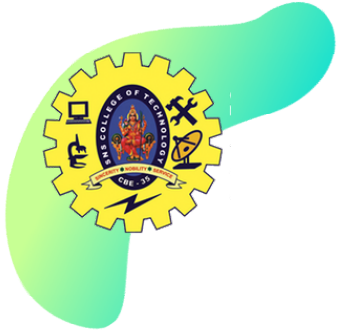


POWER TRIANGLE



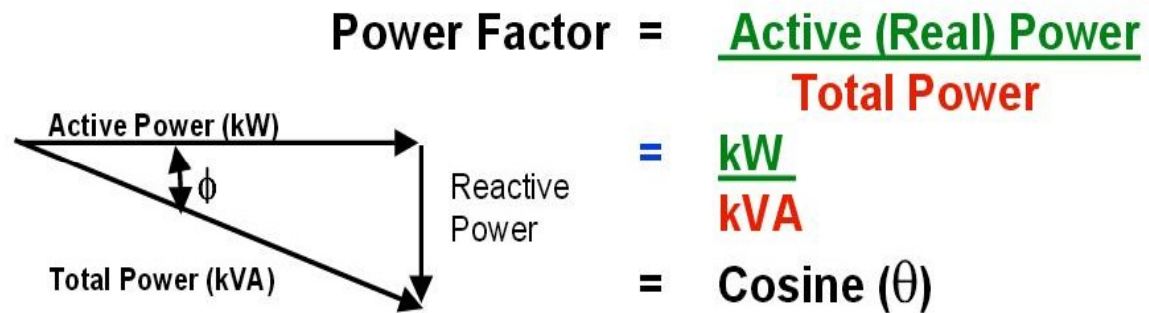
The Power Triangle:





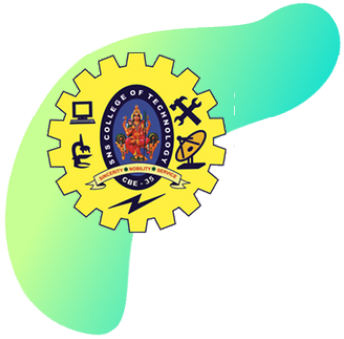
POWER FACTOR

- Power Factor is the ratio of **Active Power** to **Total Power**:

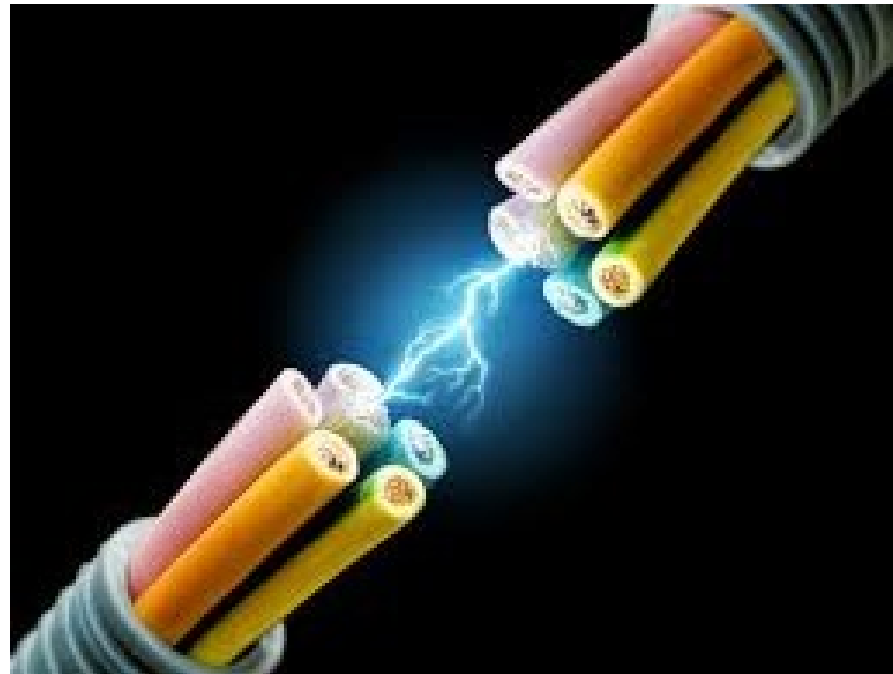


- Power Factor is a measure of efficiency (Output/Input)





RECAP....



...THANK YOU

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