SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

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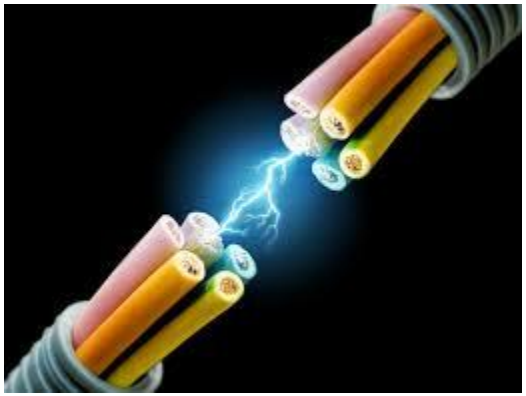
19EET103 / ELECTRIC CIRCUITS AND ELECTRON DEVICES

AC CIRCUITS

IMPEDEDANCE , POWER & POWER FACTOR

TOPIC OUTLINE

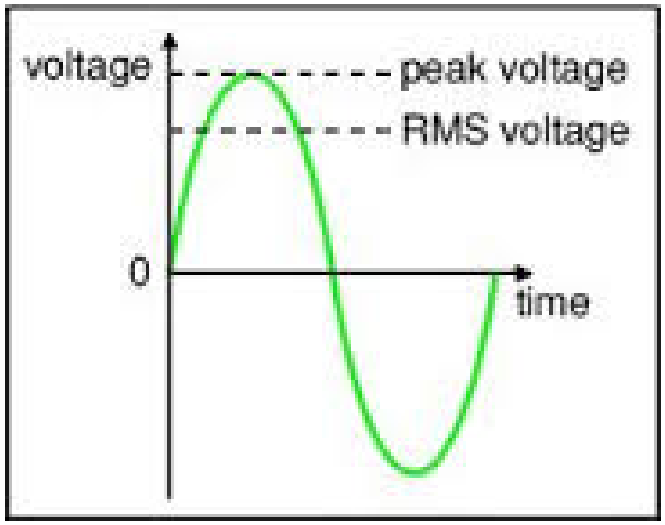
- AC fundamentals
- Peak and RMS
- Power
- Real and Reactive Power
- Power factor



AC FUNDAMENTALS

PARAMETER VALUES:

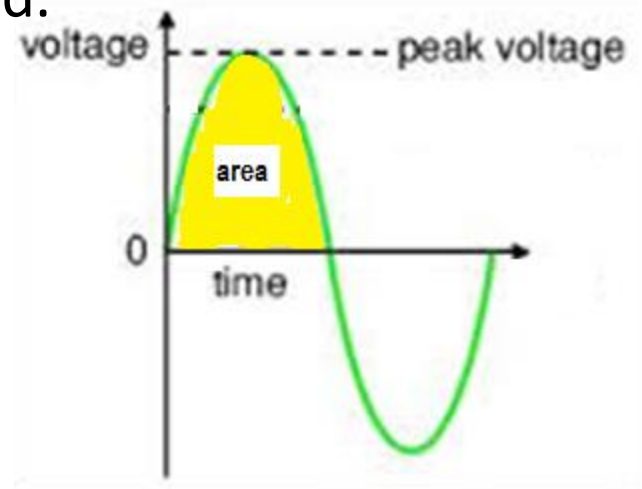
- Instantaneous (v, i)
- Peak (V_m, I_m)
- Average (V_{ave}, I_{ave})
- RMS (V, I or V_{rms}, I_{rms})



Parameters V and I are in sine wave.

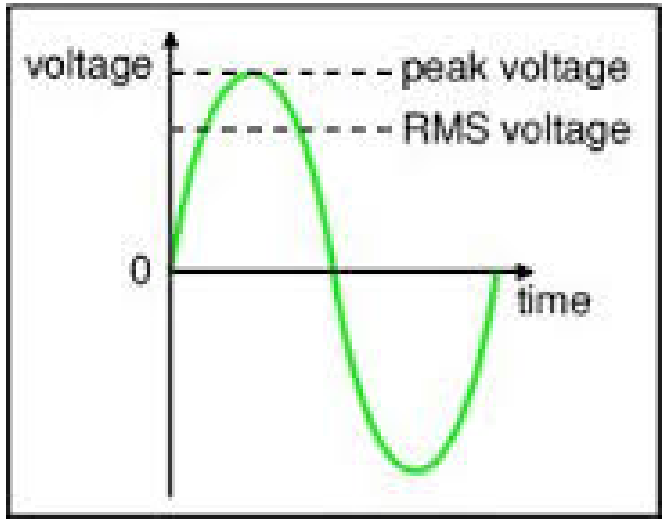
AC FUNDAMENTALS

- **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.



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

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

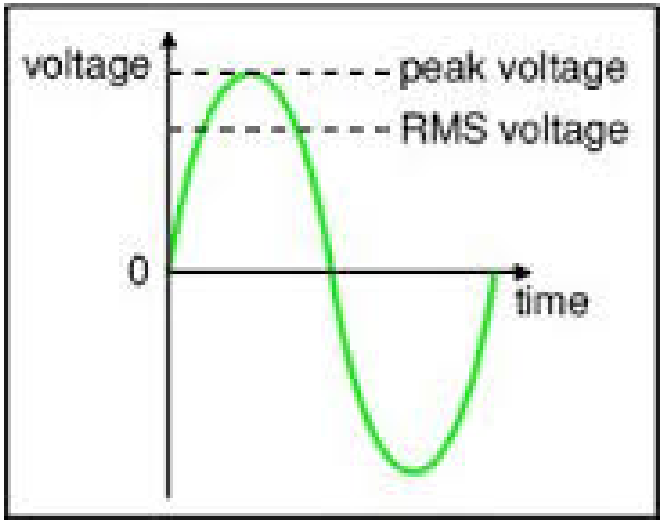
$$rms = \frac{Vpeak}{1} \quad \text{(for a symmetrical square wave)}$$

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

Impedance

3.Impedance

$$Z = \frac{v}{i} = \frac{V_m \angle 0}{I_m \angle 90} = \frac{V_m \angle 0}{V_m \omega c \angle 90} - \frac{1}{\omega c} \angle -90 = \frac{-j}{\omega c} = -j\, X_c$$

The quantity $\frac{1}{\omega c}$ is called capacitive reactance, is denoted by X_c and is measures in ohms

**** Significance of operator- j : The operator- j is used in rectangular form. It is used to indicate clock wise rotation of phasor through 90 degrees . Mathematically $-j = -\angle -1$

POWER

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

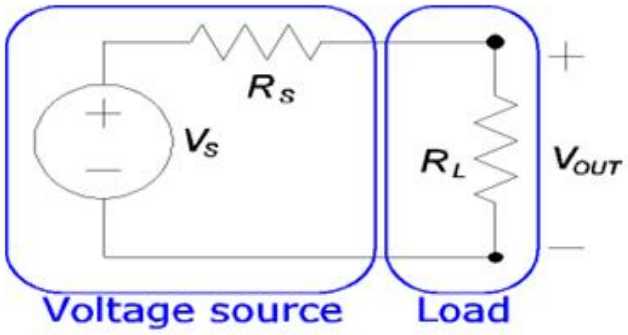
$$p = vi$$

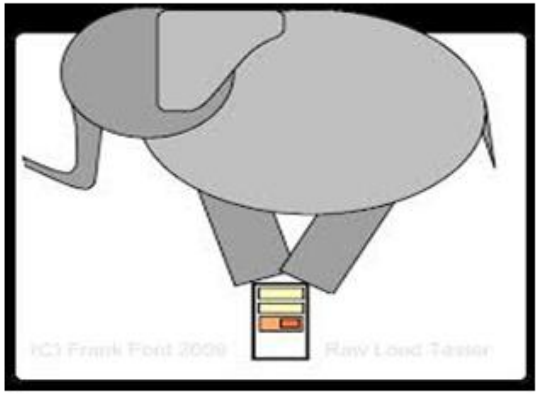
- In a **resistive circuit** the voltage and current are in phase – calculation of *p* is straightforward
- In **reactive circuits**, there will normally be some phase shift between *v* and *i*, and calculating the power becomes more complicated

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

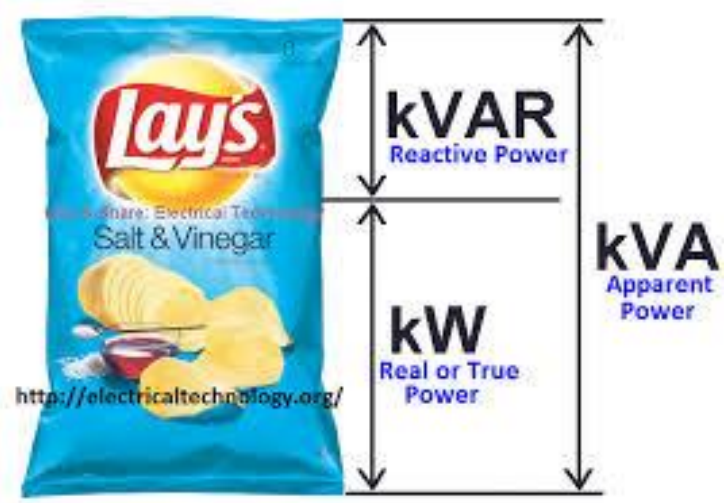
- Apparent power is the product of the current and voltage of the circuit

- 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

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

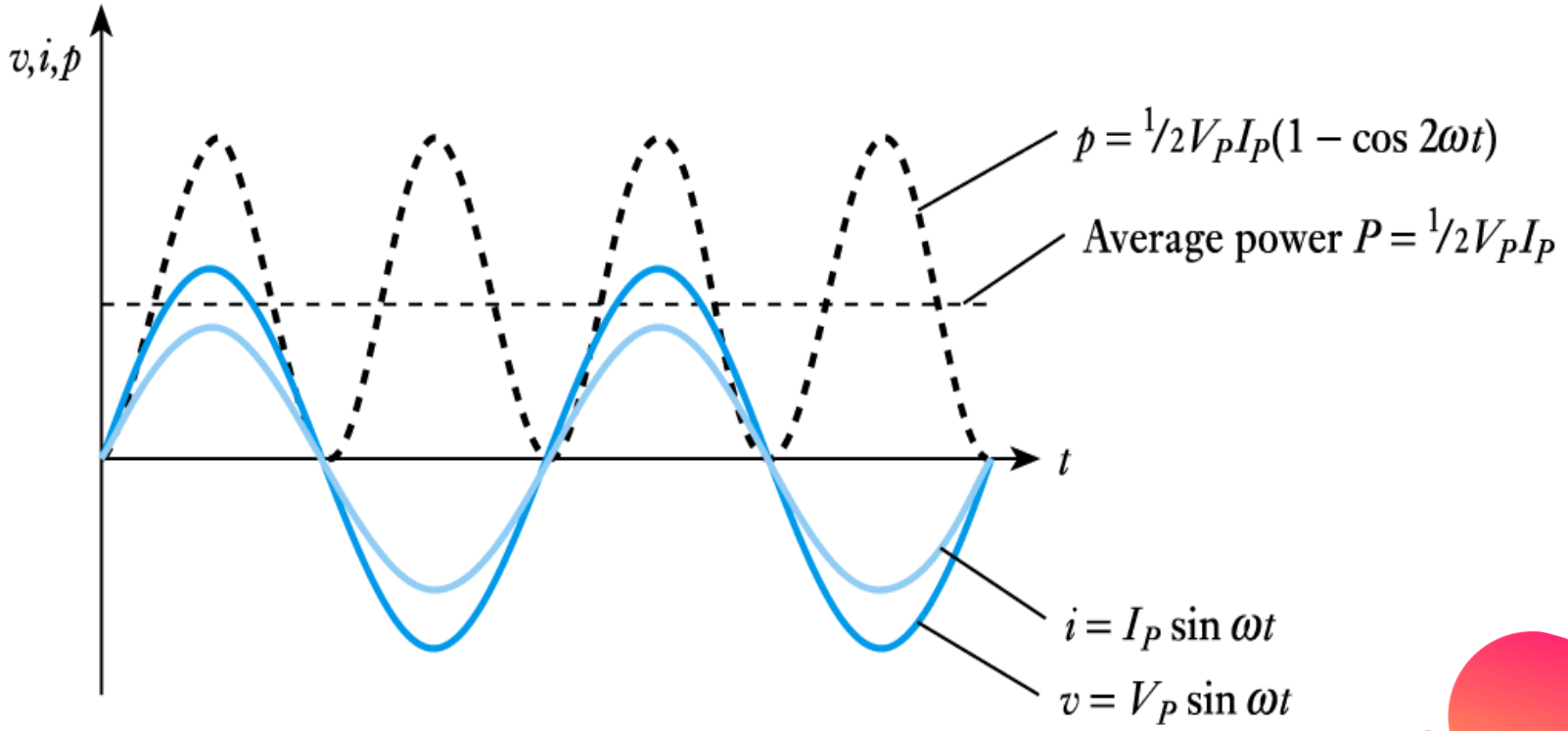


REAL AND REACTIVE POWER

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**

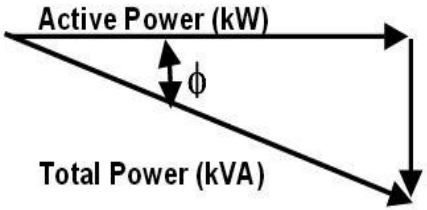
RELATIONSHIP BETWEEN *V*, *I* AND *P* IN A RESISTOR



POWER FACTOR

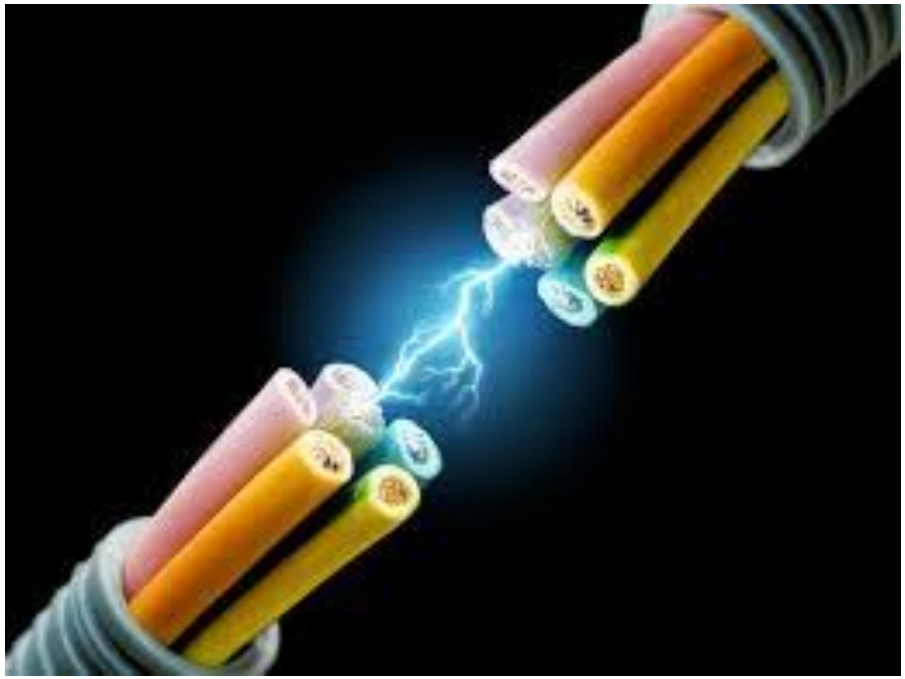
- Power Factor is the ratio of Active Power to Total Power:

$$\text{Power Factor} = \frac{\text{Active (Real) Power}}{\text{Total Power}} = \frac{\text{kW}}{\text{kVA}} = \text{Cosine } (\theta)$$



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

RECAP….



…THANK YOU