SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

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19EEB102 / ELECTRIC CIRCUIT ANALYSIS

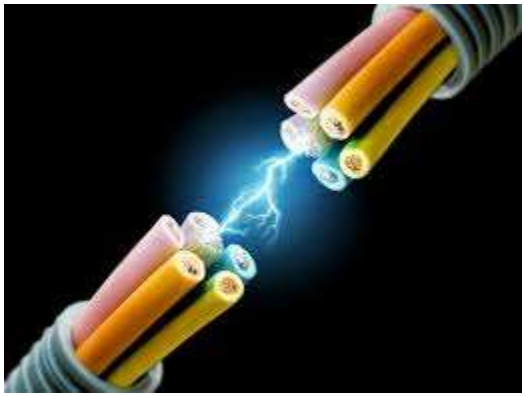
I YEAR / II SEMESTER

UNIT-III: AC CIRCUITS

POWER AND POWER FACTOR

TOPIC OUTLINE

- AC Power
- Types of Power
- Power Factor



1.POWER IN RESISTOR

- Suppose a voltage $v = V_p \sin \omega t$ is applied across a resistance *R*. The resultant current *i* will be

$$i = \frac{v}{R} = \frac{V_P \sin \omega t}{R} = I_P \sin \omega t$$

- The result power *p* will be

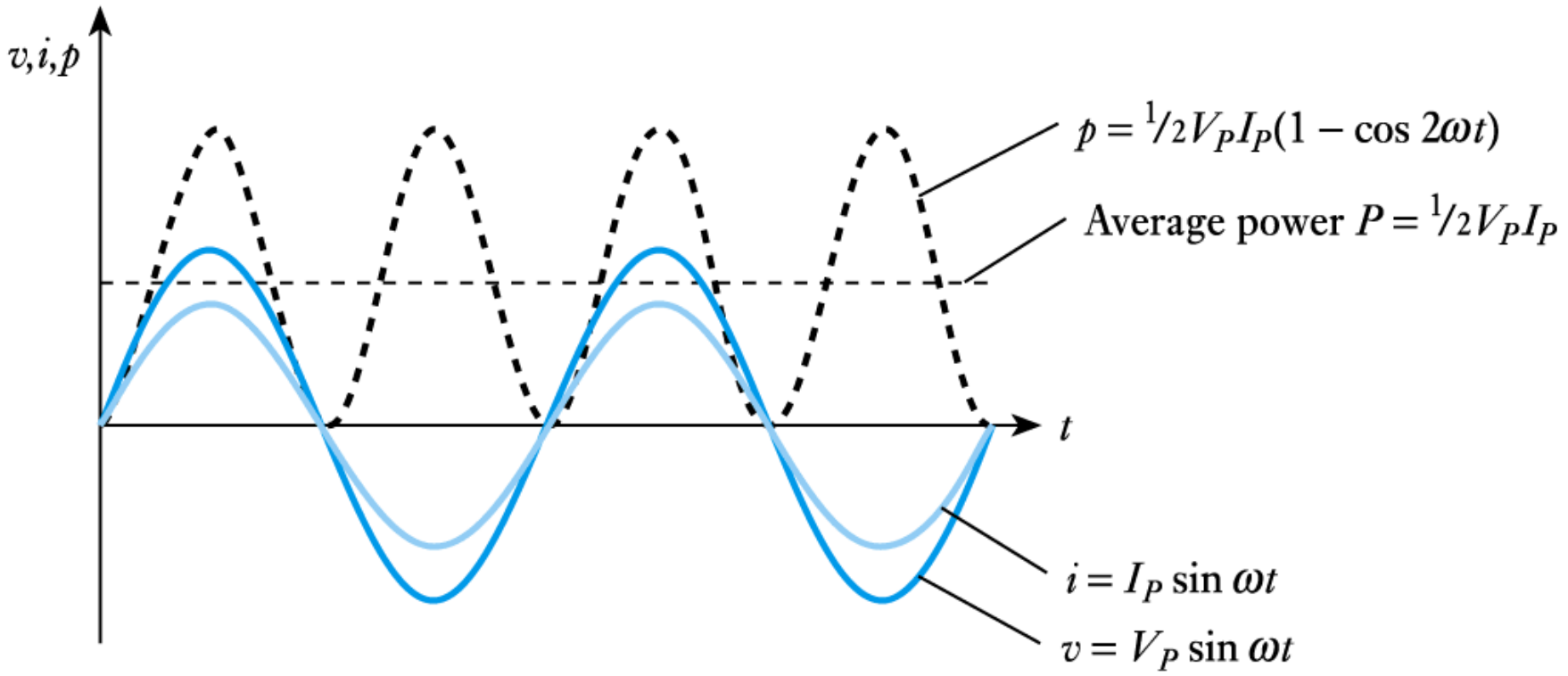
$$p = vi = V_P \sin \omega t \times I_P \sin \omega t = V_P I_P (\sin^2 \omega t) = V_P I_P (\frac{1 - \cos 2\omega t}{2})$$

- The average value of $(1 - \cos 2\omega t)$ is 1, so

$$\text{Average Power } P = \frac{1}{2} V_P I_P = \frac{V_P}{\sqrt{2}} \times \frac{I_P}{\sqrt{2}} = VI$$

where *V* and *I* are the **RMS voltage and current**

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



2.POWER IN CAPACITORS

- For capacitors we know that the current leads the voltage by 90°.
- Therefore, if a voltage $v = V_p \sin \omega t$ is applied across a capacitance *C,* the current will be given by $i = I_p \cos \omega t$
- *Then*

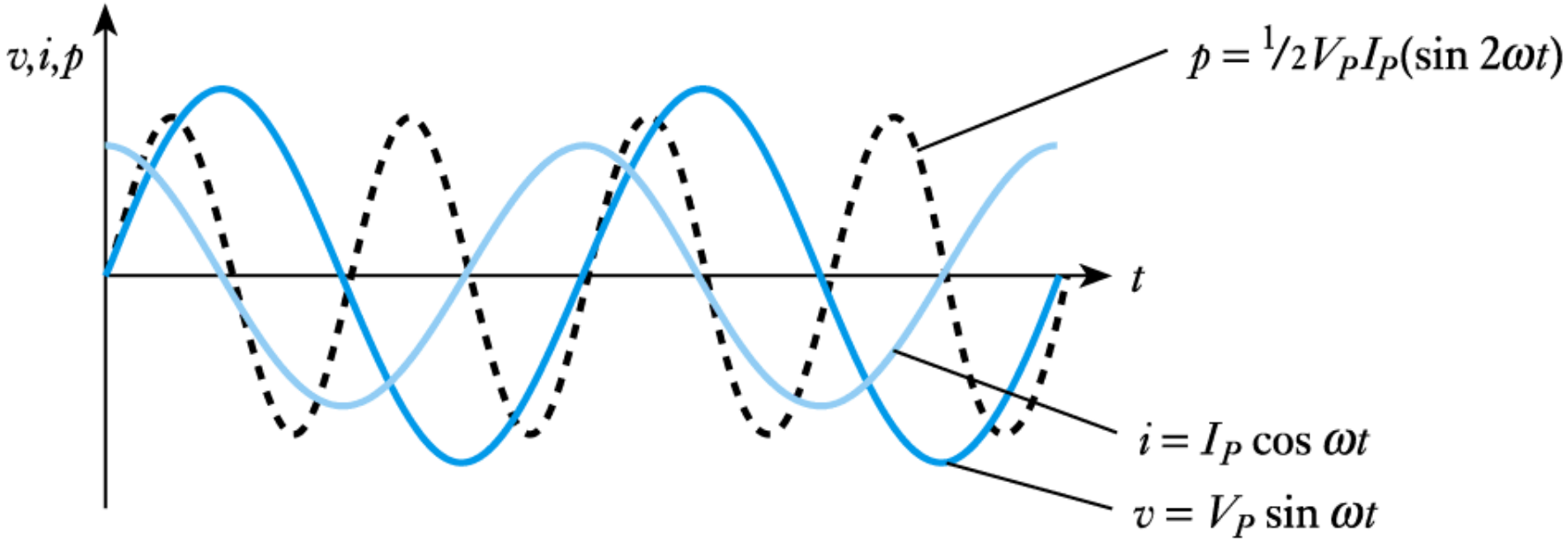
$$p = vi$$

$$= V_P \sin \omega t \times I_P \cos \omega t$$

$$= V_P I_P (\sin \omega t \times \cos \omega t)$$

$$= V_P I_P \left(\frac{\sin 2\omega t}{2}\right)$$

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



3.POWER IN INDUCTORS

For inductors we know that the current lags the voltage by 90°.

- Therefore, if a voltage $v = V_p \sin \omega t$ is applied across an inductance L, the current will be given by $i = -I_p \cos \omega t$

- Then

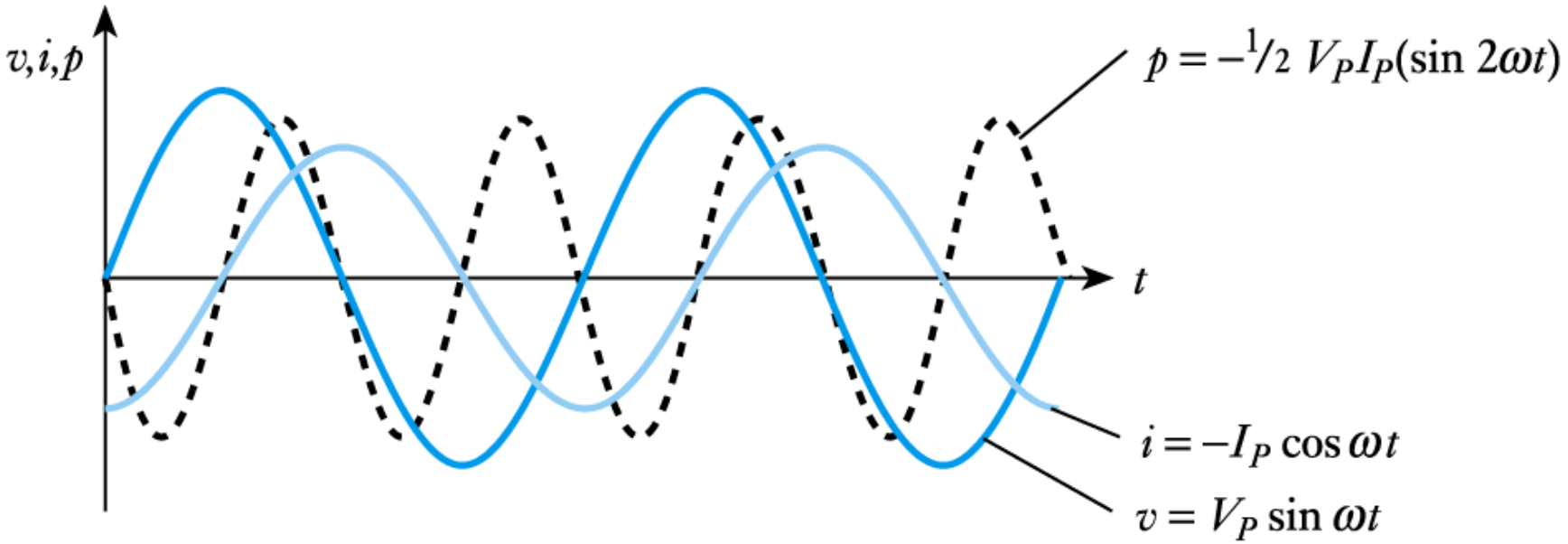
$$p = vi$$

$$= V_P \sin \omega t \times -I_P \cos \omega t$$

$$= -V_P I_P (\sin \omega t \times \cos \omega t)$$

$$= -V_P I_P \left(\frac{\sin 2\omega t}{2}\right)$$

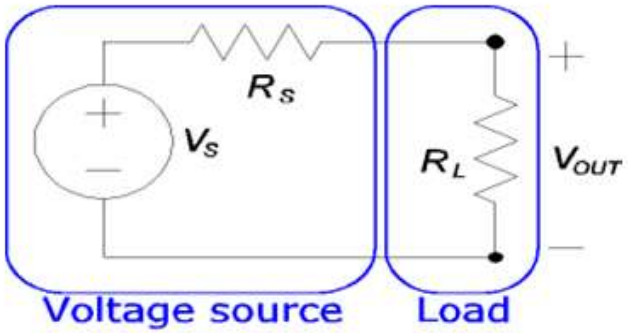
RELATIONSHIP BETWEEN *V*, *I* AND *P* IN AN INDUCTOR

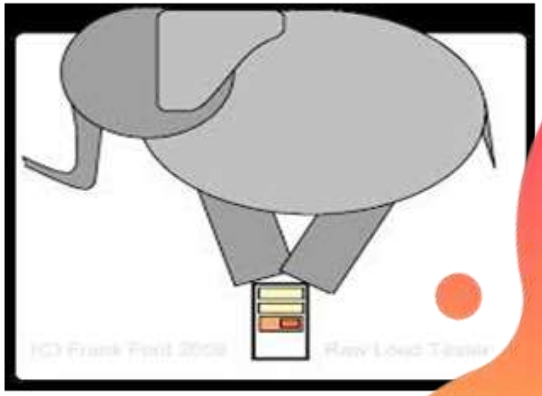


POWER

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 - TYPES

- 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

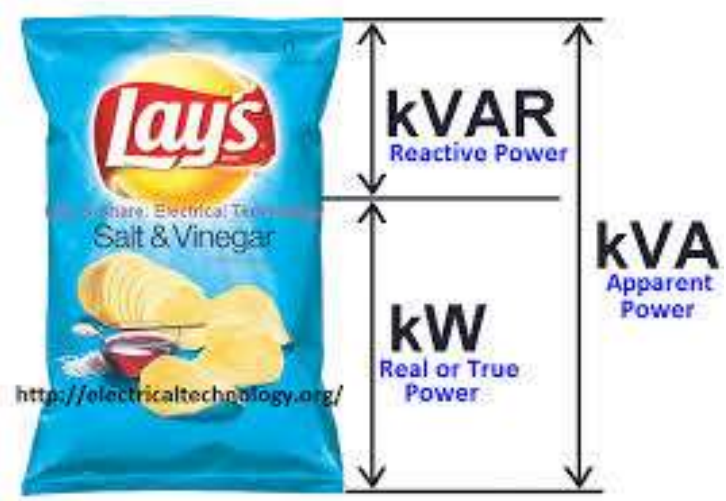
- Apparent power is the product of the current and voltage of the circuit

- 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

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

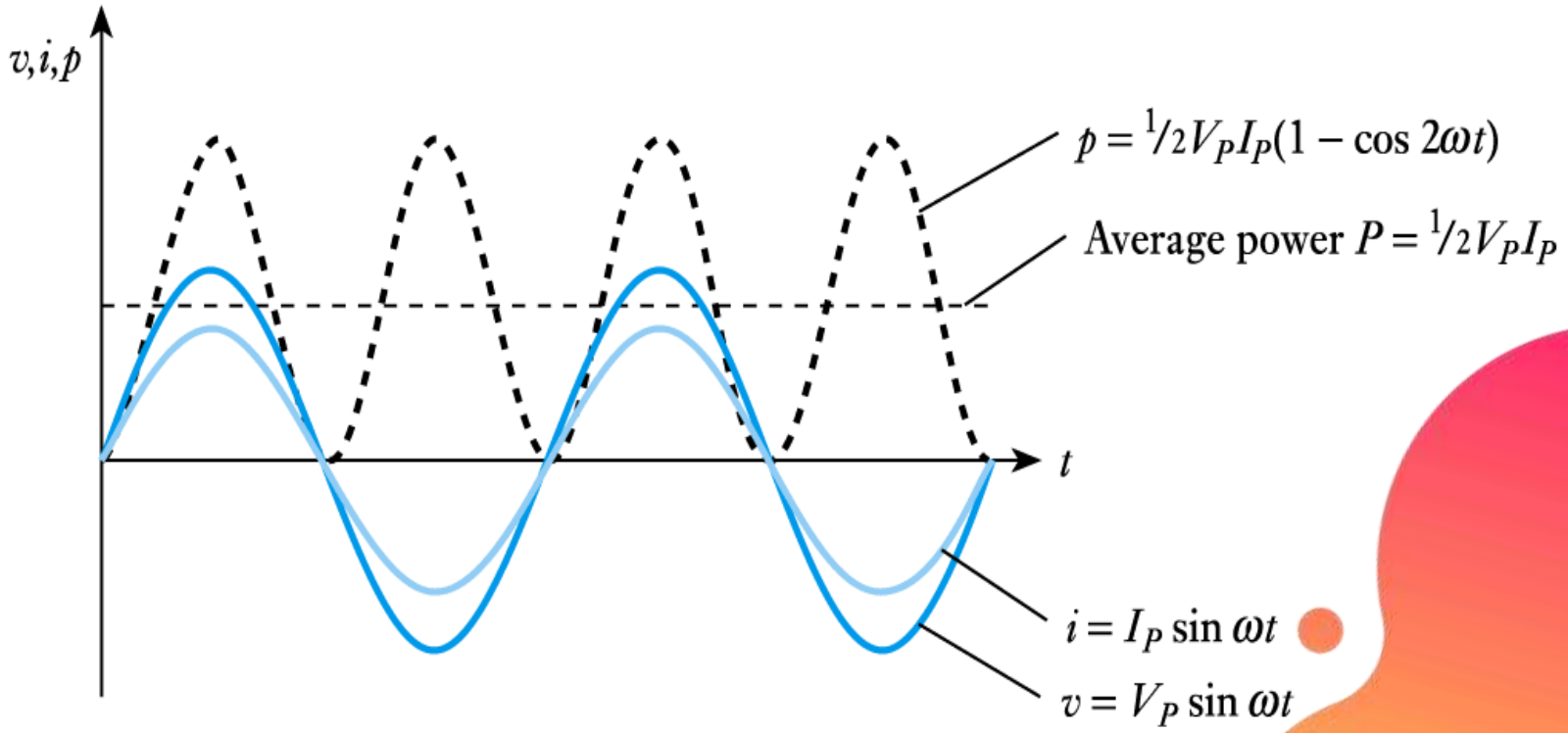


REAL AND REACTIVE POWER

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

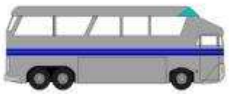


POWER TRIANGLE

The Power Triangle:

You pay for fuel for the **VERTICAL** portion of flight, as well as the fuel for the **HORIZONTAL** portion of flight.

Non-Working **(Reactive)** Power

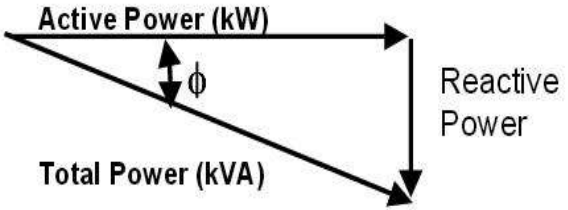


Working **(Active)** Power

POWER FACTOR

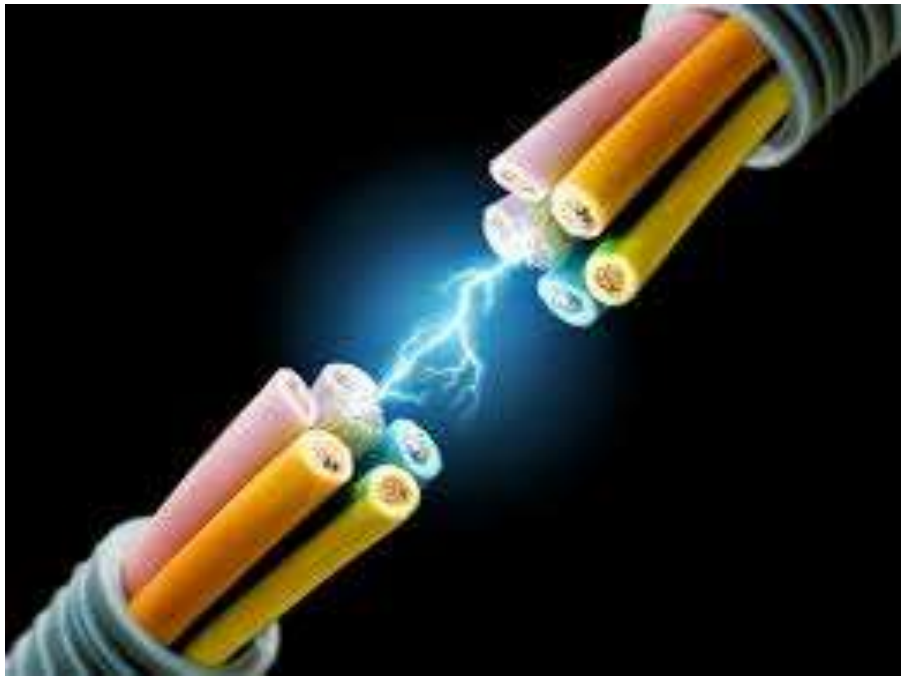
- Power Factor is the ratio of Active Power to Total Power:

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



- Power Factor is a measure of efficiency (Output/Inpu

RECAP….



…THANK YOU