REACTANCE IN AN A.C. CIRCUIT

Combined effect of R,L and C

REACTANCE IN SERIES

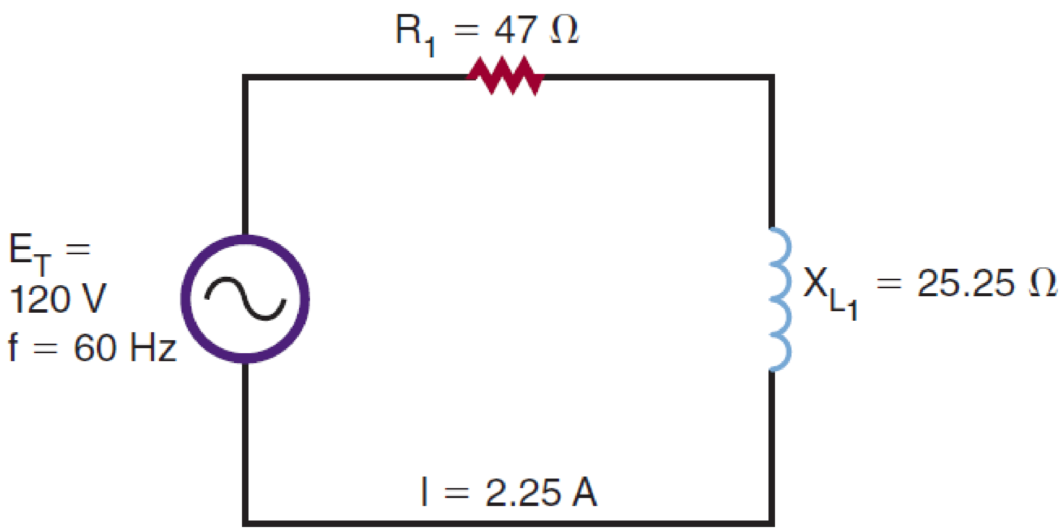
- Application of Ohm's law for D.C. Circuits
- Application of Ohm's law for A.C. Circuits

Peak Voltage	R.M.S. Voltage
↓	↓
Peak Current	R.M.S. Current

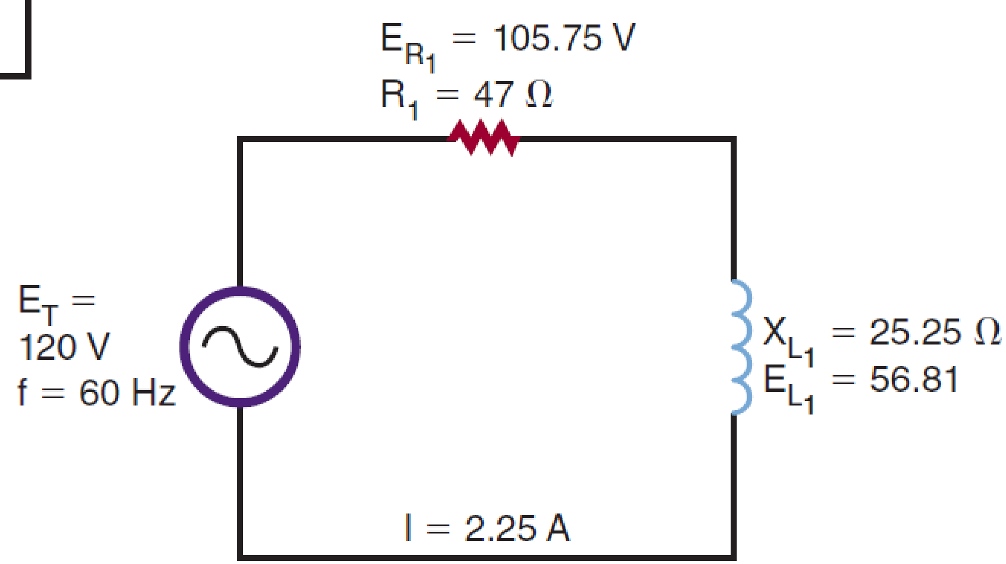
Resistive Circuits → I and V are in phase

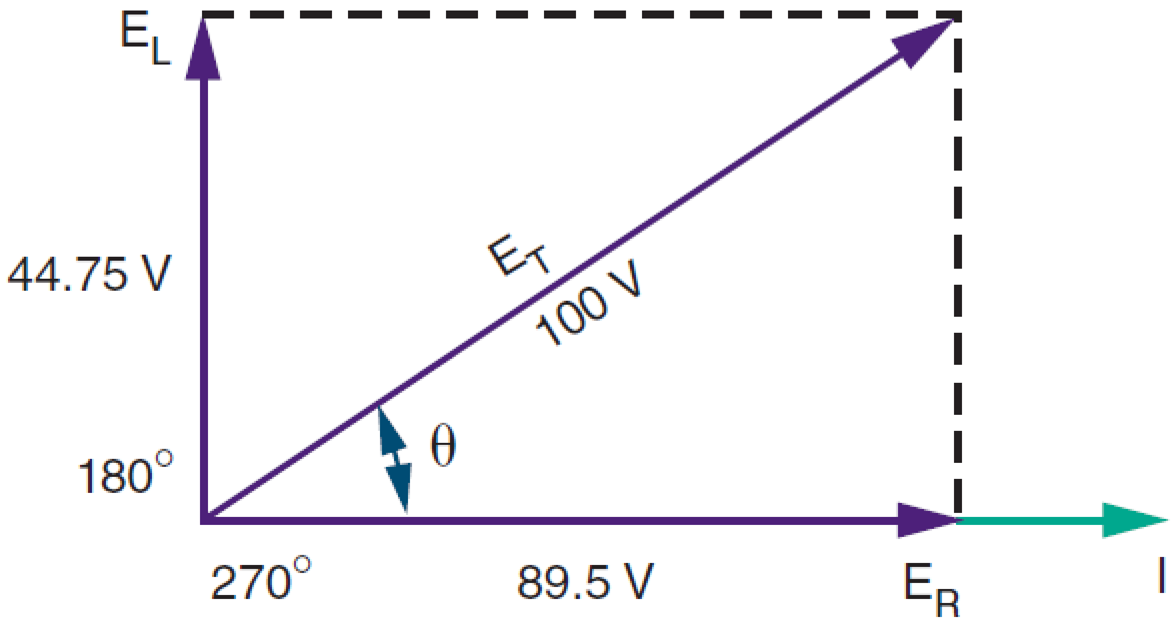
Capacitive and Inductive Circuits → I and V are 90° out of phase

COMBINATION OF REACTIVE AND RESISTIVE COMPONENTS

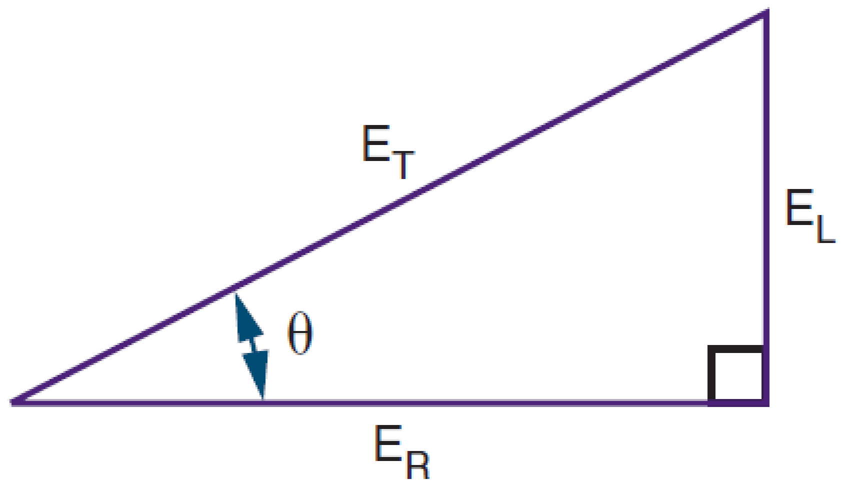


Find Voltage at each component using Ohm's Law





- Length of arrow indicates the magnitude



The angle of the Vector ET(θ) indicates the phase between the source voltage and current

$$\text{Sin}\theta = E_L/E_T$$

$$\text{Cos}\theta = E_R/E_T$$

$$\text{Tan}\theta = E_L/E_R$$

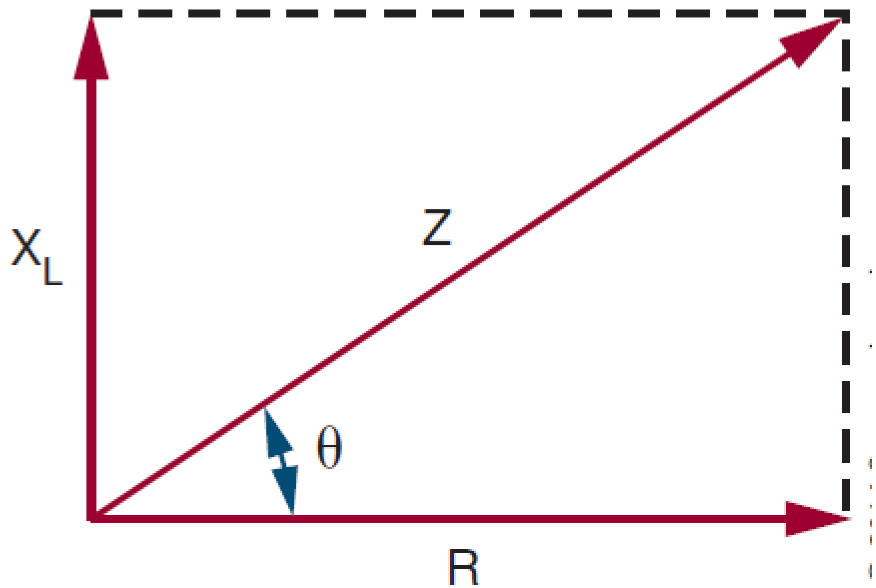
From Pythagoras theorem,

ET=√ ER2 + EL2

TIPS TO REMEMBER:

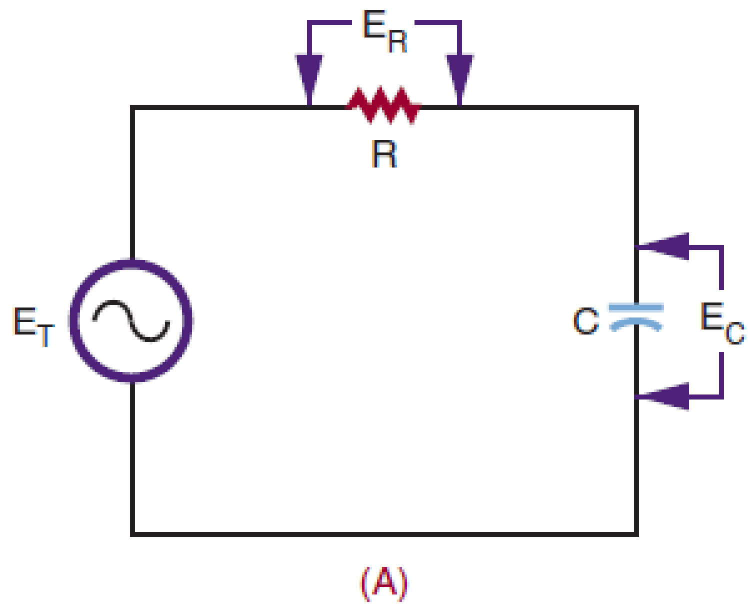
1. When Circuit is purely resistive, phase angle is 0 because V and I are in phase.
2. As X_L increases, phase angle becomes greater
3. At 45°, R and X_L are equal in value
4. When a circuit contains pure inductive reactance with no resistance, phase angle increases to 90°
5. I is same in a series circuit

1. Voltage drop is directly proportional to R or X of that component
2. So, we can have X and R vectors proportional to voltage vectors

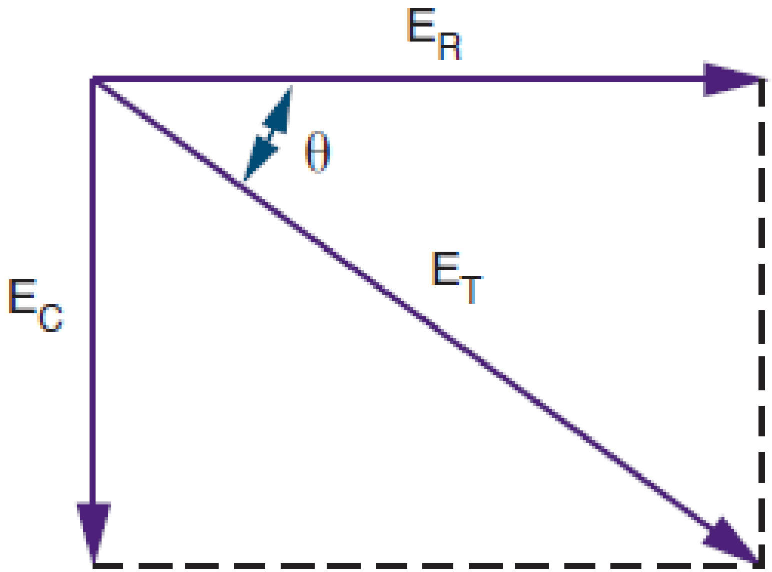


The combined effect of R and X is called as IMPEDANCE(Z)

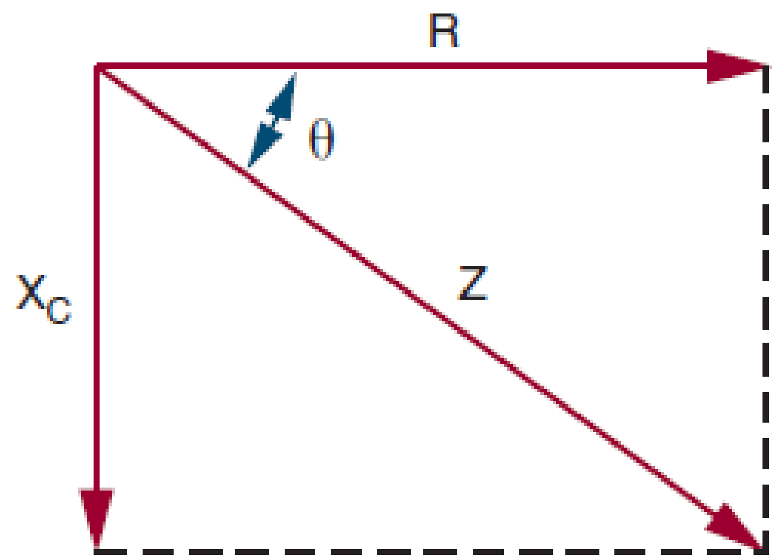
SERIES RC CIRCUIT



Draw Voltage Vectors and Resistance vectors



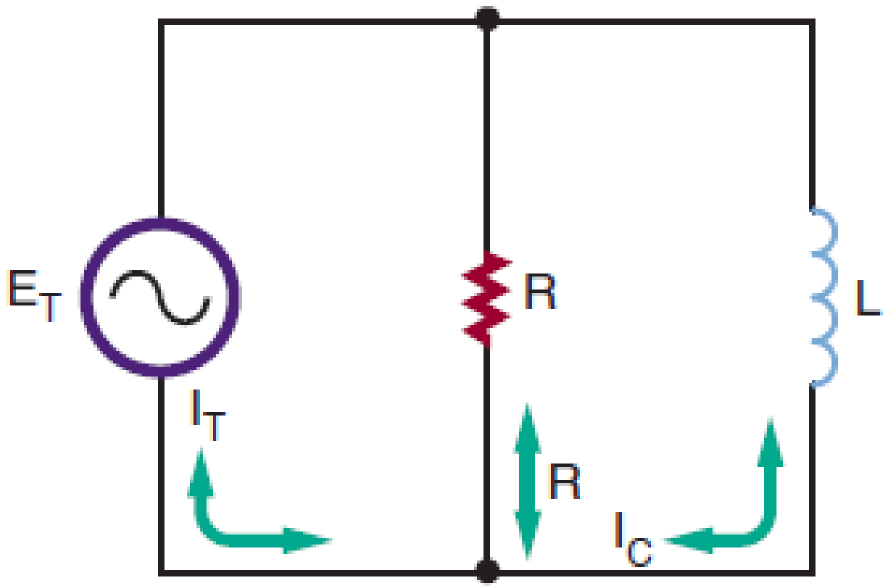
(B)

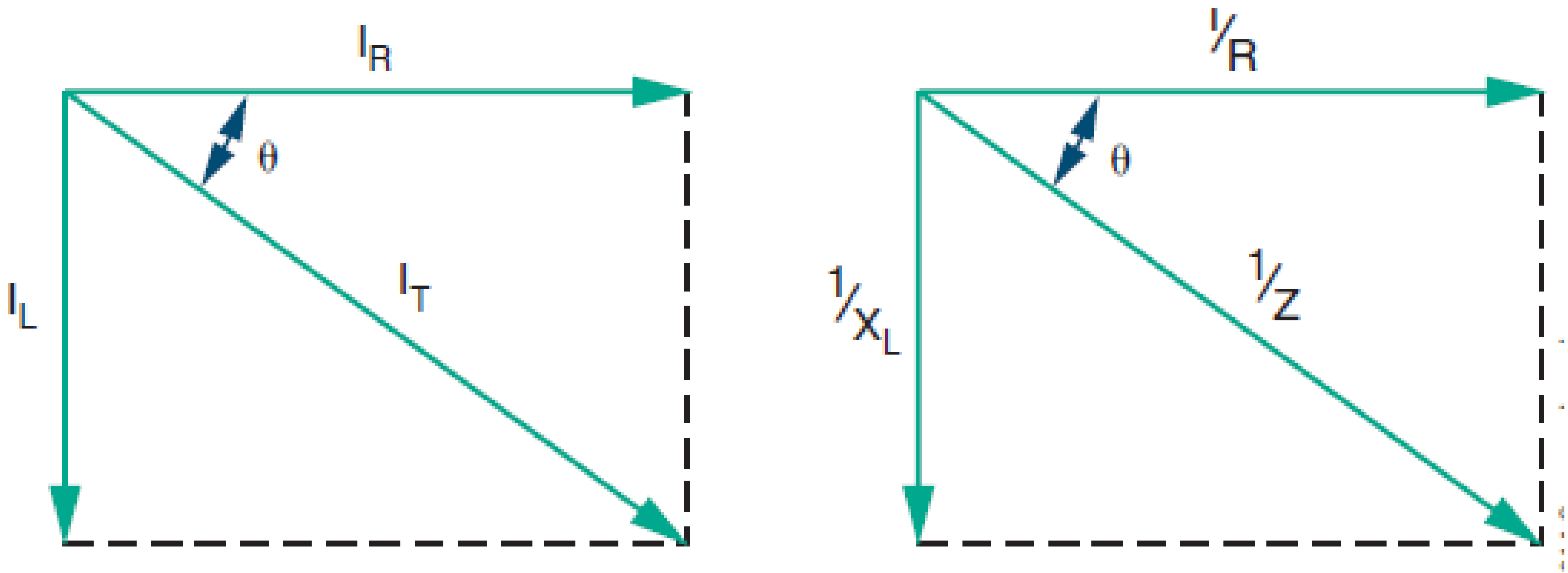


(C)

REACTANCE IN PARALLEL CIRCUIT

- Voltage in Parallel components is same

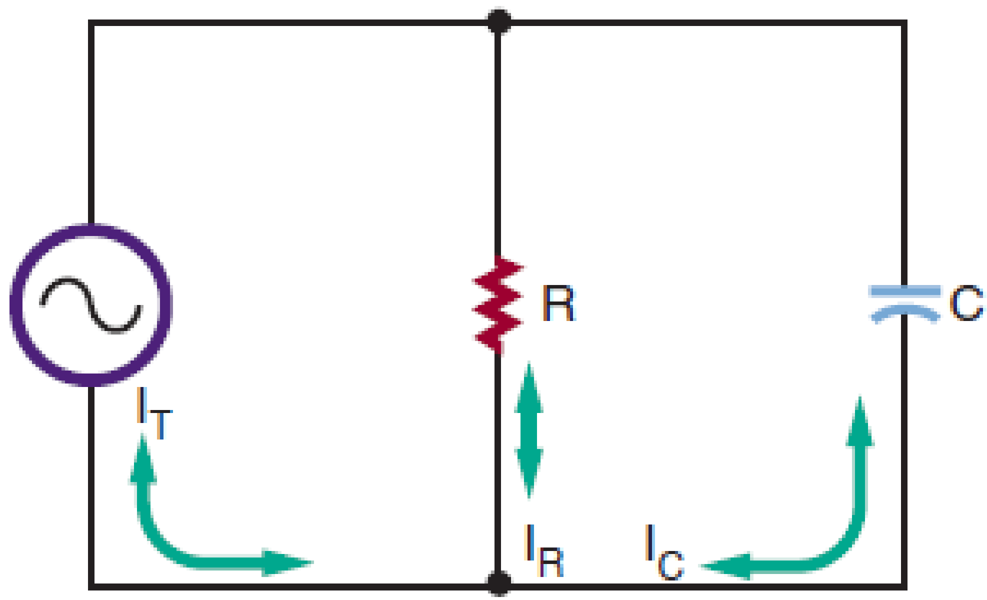


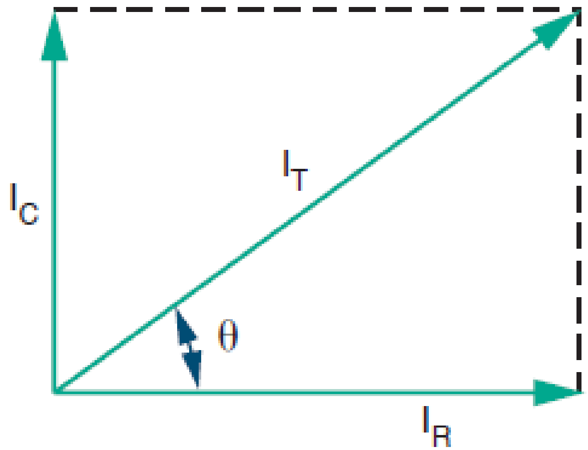


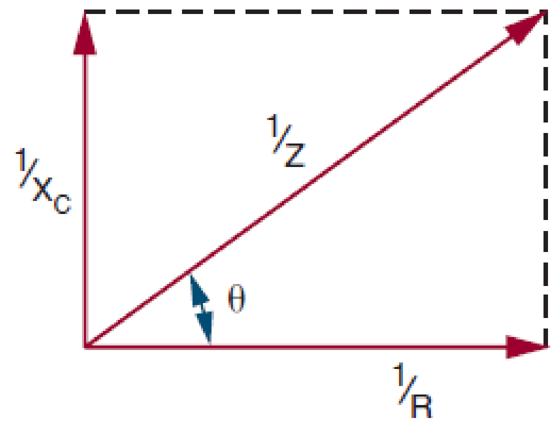
$$I = \sqrt{I_R^2 + I_L^2}$$

$$1/Z = 1/R + 1/X_L \angle 90$$

REACTANCE IN PARALLEL CIRCUIT



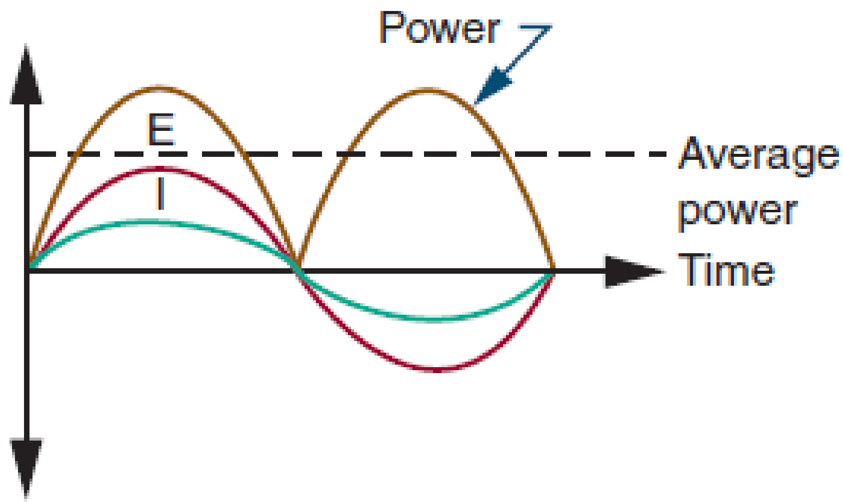




$$I = \sqrt{I_R^2 + I_C^2}$$

$$1/Z = 1/R + 1/X_C \angle -90$$

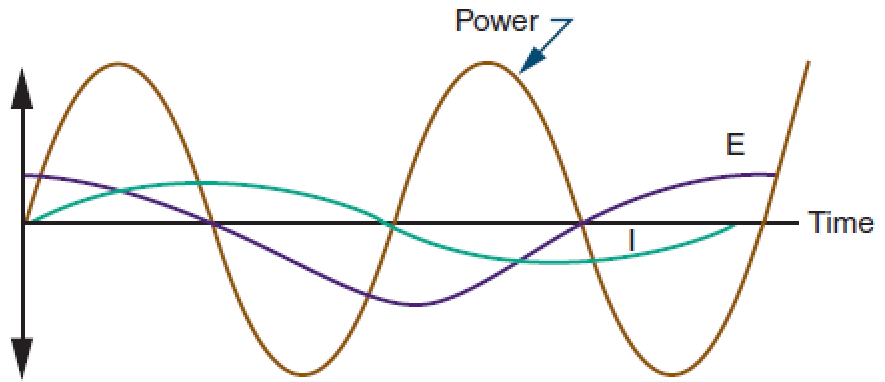
POWER



(A)

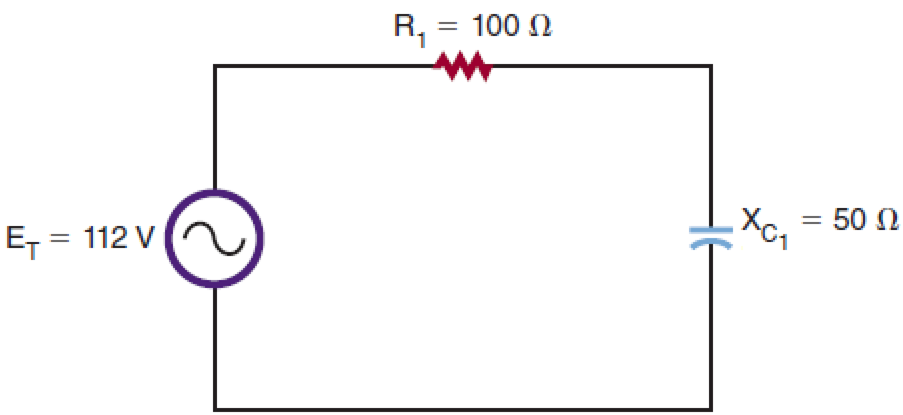
Power Dissipation in a Resistive Circuit has a non-zero value

Power Dissipation in a Reactive Circuit

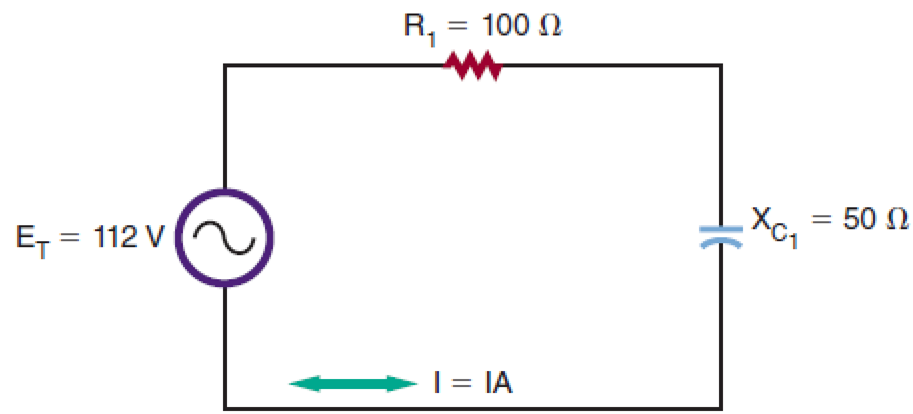


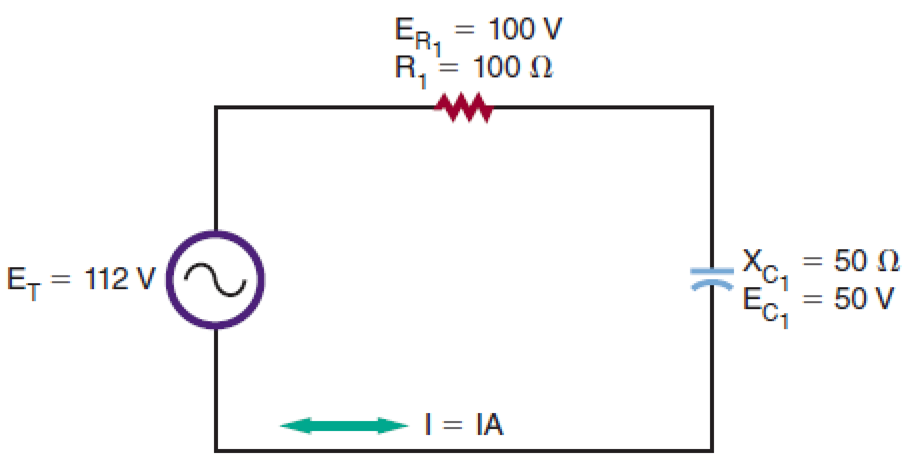
(B)

In a reactive circuit there is no average or net power loss



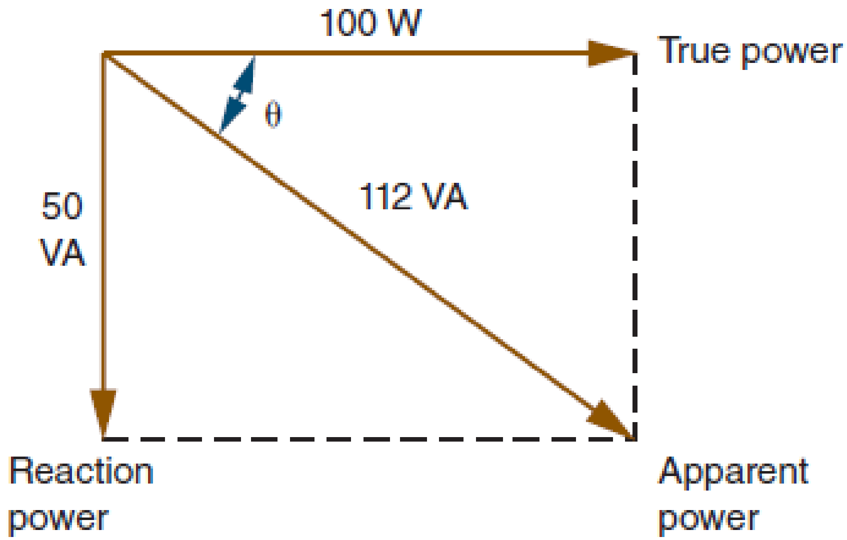
Calculate Current





Calculate voltage at each component

Calculate power at each component by VI



Power Factor= True Power/Apparent Power

Conclusions regarding Power:

- For pure resistive circuits

Power factor=1

- For pure inductive circuit

Power factor=0

- For heavy loads its important consideration that cables must be capable of handling the apparent power

INTRODUCTION TO RESONANCE

- Occurs in many fields and also in ELECTRONICS
- Device produces broadening or damping effect at resonance
- RADIO and TV RECEIVERS—TUNE at a particular frequency because of resonance.
- Tuning Circuit-C parallel L

OVERVIEW FROM PRACTICAL CLASS

- Parallel tuned ckt—Zmax
- Condition for Resonance
- R doesn’t effect Fr
- Resonant Circuits not used in audio bands of frequencies