ECE 215 Spring 2025

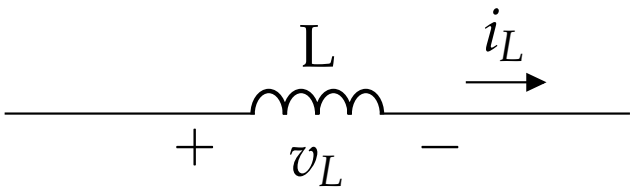
Objective 1.4: Apparent and Reactive Power

UNITED STATES
AIR FORCE
ACADEMY

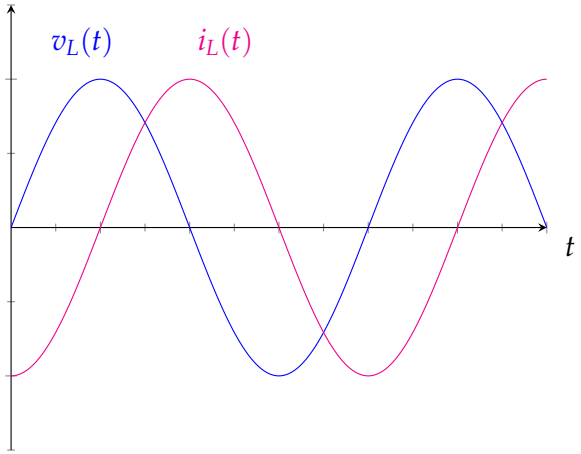
Objective 1.4

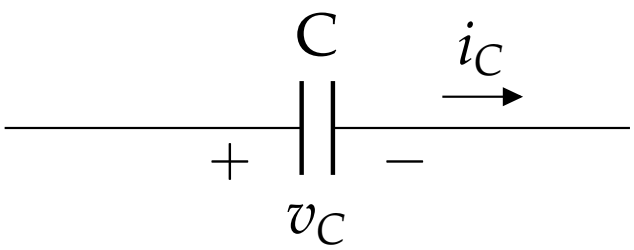
I can compute the reactive and apparent power values for an AC-powered circuit.

Other Circuit Elements

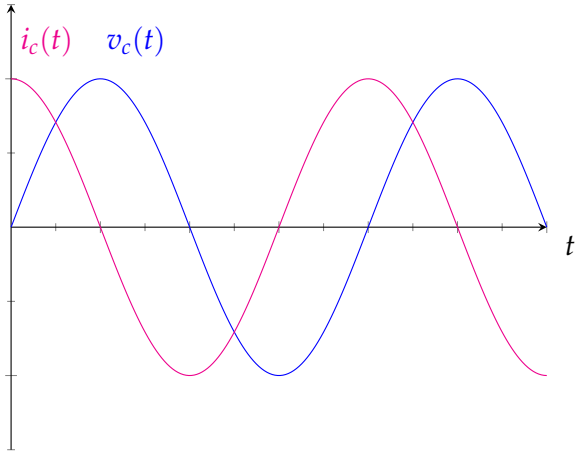


$V_L =$





$I_C =$



Other Circuit Components

Power of L and C

- Inductors and Capacitors consume no real power
- The angle between voltage & current can be between and

Consequences

If V and I are out of phase, not all $P = V_{rms} I_{rms}$ is available as real power.

General Expression for Real Power

$$P = V_{rms}\ I_{rms}\ \cos\theta_v - \theta_i$$

Where does the power go?

Definition

$S \rightarrow$ Apparent Power: the power we thought we would get, based on V_{rms} and I_{rms}.

$$S = V_{rms}\, I_{rms} \rightarrow \text{units of V-A}$$

$$\implies \text{pF} = \cos\theta_v - \theta_i = \frac{P}{V_{rms} I_{rms}} = \frac{P}{S}$$

Definition

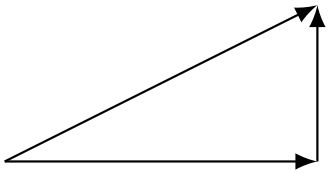
$Q \rightarrow$ Reactive Power: a quantity to account for inductive and capacitive effects in AC circuits.

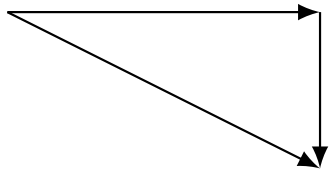
$$Q = V_{rms}\, I_{rms} \sin\theta_v - \theta_i \rightarrow \text{units of VAR}$$

Power Triangle

Putting it all together

$$[V_{rms}I_{rms}\cos\theta_v - \theta_i]^2 + [V_{rms}I_{rms}\sin\theta_v - \theta_i]^2 = [V_{rms}I_{rms}]^2$$
$$\Longrightarrow P^2 = Q^2 = S^2$$





Q =

pF is

AC Power Example

A compressor is hooked to a $440V_{rms}$ bus. It is rated at 4kW and has a lagging pF of 0.8. What I_{rms} is drawn from the bus and what reactive power (Q) is consumed by the compressor?