Course Overview

• EE 105 – new version
  – Prerequisite: EECS 40
  – analog integrated circuits + basic IC device models needed to design them
  – course incorporates a laboratory

• Related courses:
  – EE 130, 140, 141, 142

Sinusoidal Function Review

\[ v(t) = v \cos(\omega t + \phi) \]

- amplitude (half of peak-to-peak)
- frequency (radian) \( \omega = 2\pi f = 2\pi (1/T) \)
- phase (degrees or radians)
Graphical Description

\[ v_1(t) = v \cos(\omega t) \]
\[ v_2(t) = v \cos(\omega t - 45) \]
\[ \omega = \frac{2\pi}{T} \]

Why are Sinusoids Important?

• Any periodic signal \( v(t) \) can be expressed as a sum of sinusoidal signals by a Fourier series expansion (EECS 20N, EE 120)
• The response of a linear circuit to a sinusoidal input, as a function of its frequency \( \omega \), leads to insights into the behavior of the circuit.
Linear Circuits

- **Theorem:** solutions for voltages and currents in a linear circuit (i.e., one consisting of $R$, $L$, $C$ and dependent sources $G_m$, $R_m$, $A_v$, and $A_i$) with a sinusoidal signal as the input are:

RC Circuit with Sinusoidal Input

\[ v_c(t) = V_c \cos(\omega t + \phi) : \text{solution is a sinusoidal signal with the same frequency, but with a different amplitude and phase-shifted with respect to the source} \]

\[ v_s(t) = V_s \cos(\omega t) : \text{set phase of source to zero (use as the reference)} \]
Circuit Analysis

Circuit Analysis (Continued)
Graphical Result for Phase $\phi$

Graphical Result for Amplitude Ratio