Composite Waveforms- combining the basic waveforms to make really nasty stuff.

e.g, express the following curve in terms of simple waveforms:
Putting the hand on the other foot, characterize the following waveform:

\[ v(t) = \frac{r(t)}{T_C} \left[ V_A e^{-t/T_C} \right] u(t) \]
And you thought you only had two feet... characterize this waveform too:

\[ v(t) = \sin \omega_o t \left[ V_A e^{-t/T_C} \right] u(t) \]
And back to stepping on our hands, develop an equation for the following square wave:

\[ v(t) = V_A \text{ for } t \in [nT_0, (n+1)T_0) \]

where \( V_A \) is the amplitude of the square wave, and \( T_0 \) is the period of the square wave.
Back to the books...

instantaneous value vs. waveform/function/signal

**Temporal descriptors:**

- A signal is periodic iff $\exists \, T_0 \text{ s.t. } v(t+T_0)=v(t) \ \forall \ t$
- A signal is causal iff $\exists \, T \text{ s.t. } v(t)=0 \ \forall \ t<T$

*(If you can’t follow this notation, the book says the same thing in English)*
Amplitude descriptors:

When we’re out together dancing peek to peek...

peek to peek voltage (or other signal) is defined by:

\[ V_{pp} = V_{Max} - V_{Min} \]

peek voltage (or other signal) is defined by:

\[ V_p = \max(|V_{Max}|, -V_{Min}) \]
The average voltage (or other signal) over interval $T$ is defined by:

$$V_{avg} = \frac{1}{T} \int_{t}^{t+T} v(x) dx$$

Areas are equal.
Root mean square (RMS) - applying what we know to something you will see much more of in future classes

instantaneous power: \[ p(t) = \frac{1}{R} [v(t)]^2 \]

average power: \[
P_{\text{avg}} = \frac{1}{T} \int_{t}^{t+T} p(x) dx = \frac{1}{R} \left[ \frac{1}{T} \int_{t}^{t+T} [v(x)]^2 dx \right] \]

now take the square root and note that "mean"="average"

RMS voltage: \[
V_{\text{rms}} = \sqrt{\frac{1}{T} \int_{t}^{t+T} [v(x)]^2 dx} \]

finally, \[
P_{\text{avg}} = \frac{1}{R} V_{\text{rms}}^2 \]

RMS voltage provides a measure of the power carried by a periodic signal.
"If you put a tin can in the microwave, you’ll be as powerful as they are"

\[ v(t) = V_A \cos(\omega_0 t + \phi) \]

this periodic signal is characterized by three parameters:

- **Amplitude**: $V_A$
- **Frequency**: $\omega_0$
- **Phase**: $\phi$

By combining sinusoids (some times an infinite number of them), we can build any periodic signal.

In fact, if the signal of interest has a frequency $\omega_0$ (how does this relate to $T$?) we will only need to use sinusoids at the **fundamental frequency**, $\omega_0$ and **harmonic frequencies** $n \cdot \omega_0$. 