Signals: Voltages or currents that varies with time. 
Examples: Audio signals include speech and music. Musical notes (middle C is a 254 Hz sinusoid), octaves.

Periodic: \( x(t) \) has period \( T \leftrightarrow x(t) = x(t + T) \) repeats every \( T \). 
Examples: Musical tones; EKGs (heart); 60 Hz wall sockets. 
Then: Periodic signals can be decomposed into sinusoids: 

Periodic signal= sum of sinusoids at frequencies which are integer multiples of the fundamental frequency \( = \frac{1}{T} \) Hz ~ prism. Have frequency content. See Fourier series handout for details.

Circuits: Components connected together in a network. 
Components: Resistors, inductors, capacitors, sources. 
Examples: Op-amps modelled using dependent sources.

Systems: Use of a circuit to process signals to do something. 
Filters: Circuits that affect the frequency content of a signal. 
EX #1: Low-pass filters to reduce noise in sensor signals; 
EX #2: Bass and treble controls or graphic equalizers; 
EX #3: Dolby noise reduction; preemphasis and deemphasis.

Sinusoid: Signal having form \( x(t) = A \cos(\omega t + \theta) \) where: 
Amplitude: \( A \)= (usual) amplitude; \( 2A \)= peak-to-peak amplitude \( A_{pp} \); 
Amplitude: \( \frac{A}{\sqrt{2}} \approx 0.707 A = \text{rms amplitude} A_{rms} \); \( 20 \log_{10} A_{rms} = \text{dBV} \). 
Why? \( A_{pp} \) easy to measure on scope; \( A_{rms} \) for AC power (see later). 
\[ A_{rms} = \sqrt{\frac{1}{T} \int_0^T A^2 \cos^2(\omega t + \theta) dt} = \frac{A}{\sqrt{2}} \] if \( \omega \neq 0 \). \( \omega = 0 \rightarrow \text{DC value} \).

Frequency: \( \omega = \text{circular frequency in} \frac{\text{radians}}{\text{second}} \); 
Frequency: \( \omega = 2\pi f \) where \( f \)= frequency in Hertz \( \frac{\text{cycles}}{\text{second}} \). 
Period: \( T = \frac{1}{f} = \frac{2\pi}{\omega} \). Sinusoid repeats every \( T \): \( x(t) = x(t + T) \). 
Phase: \( \theta = \text{phase (shift) in radians or degrees} \). 1 radian= \( \frac{180}{\pi} \approx 57.3^\circ \).

Example: Voltage in wall socket: \( v(t) = 170 \cos(377t + \theta) \) for some \( \theta \). 
Amplitude: \( A_{\text{usual}} = 170 \) volts; \( A_{pp} = 340 \) volts; \( A_{rms} = 120 \) volts. 
Frequency: \( T = \frac{1}{60} \) seconds; \( f = 60 \) Hz; \( \omega = 377 \frac{\text{radians}}{\text{second}} \). 
where: Approximating \( 170 \approx 120\sqrt{2} \) and \( 377 \approx 2\pi 60 \) (quite close).