Preliminaries

Sinusoidal: $\sin(2\pi f_0 n)$
General Sinusoidal: $A\sin(2\pi f_0 n + \phi)$
Sampling Freq: f_s (1 sample every $t_s = \frac{1}{f_s}$ secs)
Sampled Sine Wave: $x(n) = \sin(2\pi f_0 n t_s)$
Absolute Frequency depends on f_s
Power Level: $\|x(n)\|^2, \|X(k)\|^2$

LTI system

Linear:

$$T(c_1x_1(n) + c_2x_2(n)) = c_1T(x_1(n)) + c_2T(x_2(n))$$

Time Invariant:

$$x(n) \to y(n), x(n+k) \to y(n+k)$$

Sampling

Sampled values of sinewave of f_0Hz and $f_0 + kf_s$Hz are indistinguishable.

DFT

$$X(k) = \sum_{n=0}^{N-1} x(n)e^{-j2\pi nk/N}, \quad k = 0, 2, ...N-1$$

$$x(n) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} X(k)e^{j2\pi nk/N}, \quad n = 0, 2, ...N-1$$

Decibel (Peak often normalized to 0): $20\log_{10} X(k)$
Fundamental Frequency: $\frac{f_s}{N}$
Analysis Frequency: $f_{analysis} = \frac{kf_s}{N}$
Phase: $X_\theta(k) = \tan^{-1}\left(\frac{X_{imag}(k)}{X_{real}(k)}\right)$