$$Ev\{x(t)\} = \frac{1}{2}[x(t) + x(-t)] \qquad Od\{x(t)\} = \frac{1}{2}[x(t) - x(-t)]$$

$$\cos(\omega_0 t) = \frac{1}{2}\left(e^{j\omega_0 t} + e^{-j\omega_0 t}\right) \qquad \sin(\omega_0 t) = \frac{1}{2j}\left(e^{j\omega_0 t} - e^{-j\omega_0 t}\right)$$

$$T_0 = \frac{2\pi}{|\omega_0|} \qquad e^{j\omega t} \rightarrow H(j\omega)e^{j\omega t}$$

$$E = \int_{t_1}^{t_2} |x(t)|^2 dt \qquad E = \sum_{n=n_1}^{n_2} |x[n]|^2$$

$$H(j\omega) = \int_{-\infty}^{\infty} h(\tau)e^{-j\omega\tau} dt \qquad H(z) = \sum_{k=-\infty}^{\infty} h[k]z^{-k}$$

$$x[n] * h[n] = \sum_{k=-\infty}^{\infty} x[k]h[n-k] \qquad x(t) * h(t) = \int_{-\infty}^{\infty} x(\tau)h(t-\tau)d\tau$$

$$x(t) = \sum_{k=-\infty}^{\infty} a_k e^{jk\omega_0 t} \qquad x[n] = \sum_{k=<N>} a_k e^{jk\omega_0 n}$$

$$a_k = \frac{1}{T}\int_T x(t)e^{-jk\omega_0 t} dt \qquad a_k = \frac{1}{N}\sum_{n=<N>} x[n]e^{-jk\omega_0 n}$$

Convolution is commutative, distributive, associative.
For LTI system to be causal, impulse response must be 0 for all $n < 0$
For LTI system to be stable, $\sum_{k=-\infty}^{\infty} |h[k]| < \infty$ or $\int_{-\infty}^{\infty} |h(t)|dt < \infty$

1 Bode Plots

Given a transfer function in the form

$$H(s) = A\prod \frac{(j\omega + x_n)^{a_n}}{(j\omega + y_n)^{b_n}}$$

with $a_n, b_n > 0$

1.1 Amplitude Plot

- at every value of s where $\omega = x_n$ (a zero), **increase** the slope of the line by $20 \cdot a_n dB$ per decade.
- at every value of s where $\omega = y_n$ (a pole), **decrease** the slope of the line by $20 \cdot b_n dB$ per decade.
- The initial value of the graph depends on the boundaries. The initial point is found by putting the initial angular frequency ω into the function and finding $|H(j\omega)|$.
- The initial slope of the function at the initial value depends on the number and order of zeros and poles that are at values below the initial value, and are found using the first two rules

1.2 Phase Plot

- If A is positive, start line (with slope 0) at 0 degrees
- If A is negative, start line (with slope 0) at 180 degrees
- At every $\omega = x_n$, **increase** the slope by $45 \cdot a_n$ degrees per decade, beginning one decade before $\omega = x_n$ (i.e. $x_n/10$)
- At every $\omega = y_n$, **decrease** the slope by $45 \cdot b_n$ degrees per decade, beginning one decade before $\omega = y_n$ (i.e. $y_n/10$)
- Flatten the slope again when the phase has changed by $90 \cdot a_n$ degrees (for a zero) or $90 \cdot b_n$ degrees (for a pole)
- After plotting one line for each pole or zero, add the lines together to obtain the final phase plot.