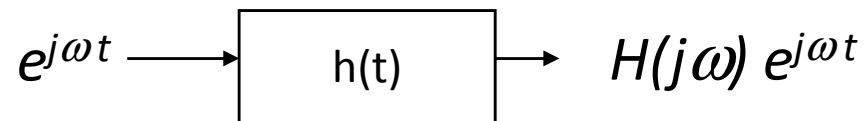
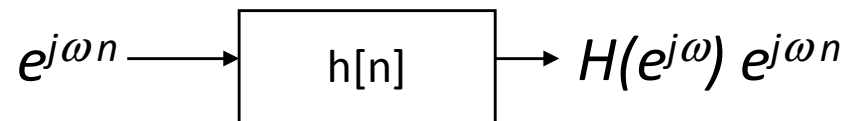


Complex exponentials as input to LTI systems



$$H(j\omega) = \int_{-\infty}^{\infty} h(t) e^{-j\omega t} dt$$



$$H(e^{j\omega}) = \sum_{n=-\infty}^{\infty} h[n] e^{-j\omega n}$$

Cos as input... use Euler formula

LCC Differential equation

- 1st order: $y'(t) + a y(t) = x(t)$
- Homogenous solution/ zero input / natural response:
 $y'_h(t) = -a y_h(t)$
 $y_h(t) = e^{-at}$
- Solution to $x(t) = \delta(t)$, with zero initial condition
 $y(t) = h(t) = e^{-at} u(t)$
- What is initial rest condition:
 $x(t) = 0, \text{ for } t \leq t_0$
 $y(t) = 0, \text{ for } t \leq t_0$
- If zero initial condition (initially at rest) is imposed: equation is describing LTI and causal system.

LCC Difference equation

- 1st order: $y[n] - a y[n-1] = x[n]$
- Homogenous solution/ zero input / natural response:
 $y_h[n] = a y_h[n-1]$
 $y_h[n] = a^n$
- Solution to $x[n] = \delta[n]$, with zero initial condition
 $y[n] = h[n] = a^n u[n]$
- Use initial rest condition to find particular solution:
 $x[n] = 0, \text{ for } n \leq n_0$
 $y[n] = 0, \text{ for } n \leq n_0$
- If zero initial condition (initially at rest) is imposed: equation is describing LTI and causal system.

LCC Differential equation

- Nth order:
$$\sum_{k=0}^N a_k y^{(k)}(t) = \sum_{k=0}^M b_k x^{(k)}(t)$$
- 1st order: $y'(t) + a y(t) = b x(t)$
- Homogenous solution/ zero input / natural response:
 $y'_h(t) = -a y_h(t)$
 $y_h(t) = e^{-at}$
- Solution to $x(t) = \delta(t)$, with zero initial condition:
 $y(t) = h(t) = b e^{-at} u(t)$
 $\delta(t)$ is changing the output instantaneously.
- Zero initial condition:
 $x(t) = 0, \text{ for } t \leq t_0$
 $y(t) = 0, \text{ for } t \leq t_0$
- If zero initial condition (initially at rest) is imposed: equation is describing LTI and causal system.

LCC Difference equation

- Nth order:
$$\sum_{k=0}^N a_k y[n-k] = \sum_{k=0}^M b_k x[n-k]$$
- 1st order: $y[n] - a y[n-1] = x[n]$
- Homogenous solution/ zero input / natural response:
 $y_h[n] = a y_h[n-1]$
 $y_h[n] = a^n$
- Solution to $x[n] = \delta[n]$, with zero initial condition
 $y[n] = h[n] = a^n u[n]$
- Initial rest condition:
 $x[n] = 0, \text{ for } n \leq n_0$
 $y[n] = 0, \text{ for } n \leq n_0$
- If zero initial condition (initially at rest) is imposed: equation is describing LTI and causal system.