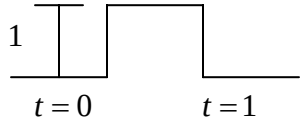
$$\dot{y} + ky = u$$

output input

$$u(t) = a_1 u_1(t) + a_2 u_2(t)$$



$$u(t) = 1 * u_s(t) + 1 * u_s(t-1)$$

$$y(t) = a_1 y_1(t) + a_2 y_2(t)$$

$$\dot{y}_1 + ky_1 = u_1 \qquad \dot{y}_2 + ky_2 = u_2$$

$$(a_1\dot{y}_1 + a_2\dot{y}_2) + k(a_1 y_1 + a_2 y_2) = a_1(\dot{y}_1 + ky_1) + a_2(\dot{y}_2 + ky_2) = a_1 u_1 + a_2 u_2 = u$$

$$\int_{t=a}^{t=b} \delta(t) f(t) dt = f(0) \quad a < 0 \qquad b > 0$$

$$\int_{t=0^-}^{t=b>0} \delta(t) f(t) dt = f(0) \qquad \int_{t=0^+}^{t=b>0} \delta(t) f(t) dt = 0$$

$$u(t) = \int_{-\infty}^{\infty} \delta(t-\tau) u(\tau) d\tau$$

$h(t)$ is the response to $\delta(t)$

$h(t-\tau)$ is the response to $\delta(t-\tau)$

$$y(t) = \int_{-\infty}^{\infty} h(t-\tau) u(\tau) d\tau$$

$$u = h * u = u * h$$

$$u(t) = e^{st} \quad \text{where} \quad s = x + jy$$

$$e^{x+jy} = e^x(\cos y + j \sin y)$$

$$a \cos wt = \frac{a}{2}((\cos \omega t + j \sin \omega t) + (\cos \omega t - j \sin \omega t)) = \frac{a}{2}(e^{j\omega t} + e^{-j\omega t})$$

$$y(t) = \int_{-\infty}^{\infty} h(\tau) e^{s(t-\tau)} d\tau = e^{st} \int_{-\infty}^{\infty} h(\tau) e^{-s\tau} d\tau = H(s)$$

$$y(t) = a\left|H(j\omega)\right| \cos(\omega t + \angle H(j\omega))$$