2000.

一、

问题:

1. $h(t) = \delta(t) * [h_1(t) + h_2(t) * h_1(t) * h_3(t)]$

$= h_1(t) + h_2(t) * h_1(t) * h_3(t)$

$= u(t) - u(t-1)$

2. $r(t) = e(t) * h(t) = \int_{-\infty}^{+\infty} h(\tau)\cdot e(t-\tau)d\tau$

$= \int_0^1 e^{-(t-\tau)} u(t-\tau)d\tau = e^{-t}\int_0^1 e^{\tau} u(t-\tau)d\tau$

$t<0$ 时 $r(t)=0$

当 $t>0$ 时 $r(t) = \int_0^t e^{\tau-t}d\tau = 1-e^{-t}$

$t>1$ 时 $r(t) = \int_0^1 e^{\tau-t}d\tau = e^{1-t}-e^{-t}$

二、~~$R(j\omega) = \frac{1}{2\pi}E(j\omega) * \pi[\delta(\omega+1)+\delta(\omega-1)]$~~

~~$= \frac{1}{2}\{E[j(\omega+1)] + E[j(\omega-1)]\}$~~

~~$= u(\omega+2) - u(\omega-2)$~~

~~又 $r(t) = 4 Sa(\omega)$~~

~~∴~~

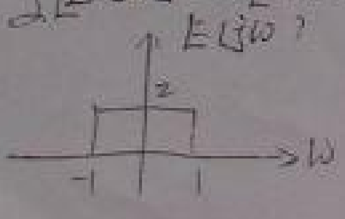
$E[j(\omega+1)] + E[j(\omega-1)] = 2[u(\omega+2) - u(\omega-2)]$

由傅里叶变换对偶性

$r(t) = \frac{2}{\pi} Sa\, 2t$

$\therefore e(t) = \frac{2}{\pi}\frac{\sin 2t}{2t}\cdot\frac{1}{\cos t} = \frac{1}{\pi}\frac{2\sin t}{t} = \frac{2}{\pi} Sa\, t$

故 $E(j\omega) = 2[u(\omega+1) - u(\omega-1)]$



四、

问题:

1. 特征方程: $\alpha^2+3\alpha+2=0$

特征根: $\alpha_1=-1$ $\alpha_2=-2$

① 求零输入响应:

$r_{zi}(t) = A_1 e^{-t} + B_1 e^{-2t}$

$\begin{cases} A_1+B_1=0 \\ -A_1-2B_1=1 \end{cases}$ $\quad A_1=1$, $B_1=-1$

$r_{zi}(t) = e^{-t} - e^{-2t}$

② 求零状态响应:

系统方程: $r''(t)+3r'(t)+2r(t)=\delta(t)$

设 $\begin{cases} r''(t) = a\delta(t) + b\Delta u(t) \\ r'(t) = a\Delta u(t) \\ r(t) = at\Delta u(t) \end{cases}$

则 $a=1$

$\therefore \begin{cases} r_{zs}(0_+) = 0 + r_{zs}(0_-) = 0 \\ r'_{zs}(0_+) = 1 + r'_{zs}(0_-) = 1 \end{cases}$

设 $r_{zs}(t) = A_2 e^{-t} + B_2 e^{-2t}$

$\begin{cases} A_2+B_2=0 \\ -A_2-2B_2=1 \end{cases}$ $\quad A_2=2$, $B_2=-2$

$r_{zs}(t) = e^{-t} - e^{-2t}$

$r(t) = 2e^{-t} - 2e^{-2t}$ $\quad t>0$

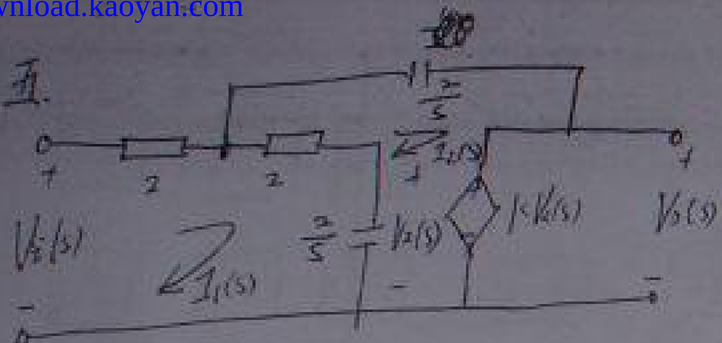
只有暂态响应 没有稳态响应

只有自由响应 没有强迫响应

2. $H(s) = \frac{s}{s^2+3s+2} = \frac{-1}{s+1} + \frac{2}{s+2}$

$\therefore h(t) = (-e^{-t} + 2e^{-2t})u(t)$

五.



解:

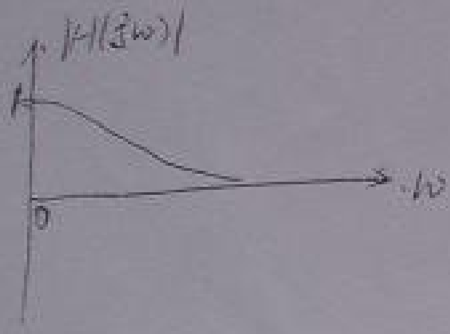
1. $$\begin{cases} I_1(s)\left(2+2+\frac{2}{s}\right) - I_2(s)\left(2+\frac{2}{s}\right) = V_1(s) \\ I_2(s)\left(\frac{4}{s}+2\right) - I_1(s)\left(2+\frac{2}{s}\right) = -kV_2(s) \\ V_2(s) = (I_1 - I_2)\frac{2}{s} \\ kV_2(s) = V_0(s) \end{cases}$$

$$H(s) = \frac{V_0(s)}{V_1(s)} = \frac{k}{s^2+(3-k)s+1}$$

2. $k=1$ 时

$$H(s) = \frac{k}{(s+1)^2}$$

$s=-1$ 二阶极点



3. 若要系统稳定则

$3-k \geq 0 \quad k \leq 3$

4. $k=3$ 时临界稳定:

$$H(s) = \frac{3}{s^2+1}$$

$$h(t) = 3\sin(t)\,u(t)$$

六.

1.

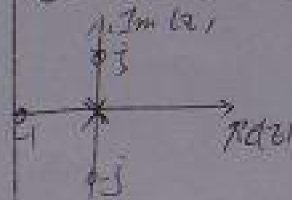
$$\frac{1}{4}x(n) + \frac{1}{4}x(n-1) + \frac{1}{4}x(n-2) + \frac{1}{4}x(n-3) = y(n)$$

2. $$H(z) = \frac{Y(z)}{X(z)} = \frac{1}{4}\left(1+z^{-1}+z^{-2}+z^{-3}\right)$$

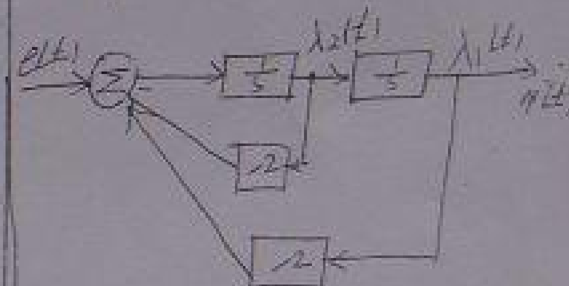
3. $$H(z) = \frac{\frac{1}{4}(1-z^{-4})}{1-z^{-1}} = \frac{1}{4}\cdot\frac{1+z^{3}+z^{2}+z}{z^{3}}$$

$z=0$ 三阶极点

$(z+1)(z^2+1)$ $z=-1$ $z=\pm j$ 是三个零点.



七解:



$$\begin{cases} \lambda_1'(t) = \lambda_2(t) \\ \lambda_2'(t) = -2\lambda_1(t) - 2\lambda_2(t) + e(t) \end{cases}$$

$r(t) = \lambda_1(t)$

$$\begin{bmatrix} \lambda_1'(t) \\ \lambda_2'(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -2 \end{bmatrix}\begin{bmatrix} \lambda_1(t) \\ \lambda_2(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} e(t)$$

$$r(t) = \begin{bmatrix} 1 & 0 \end{bmatrix}\begin{bmatrix} \lambda_1(t) \\ \lambda_2(t) \end{bmatrix}$$

$A = \begin{bmatrix} 0 & 1 \\ -2 & -2 \end{bmatrix}$ $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ $C = \begin{bmatrix} 1, 0 \end{bmatrix}$

$D = 0$

1)