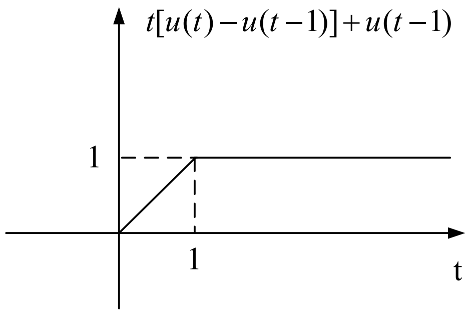
一、

1 $\frac{\pi}{6}+\sin\frac{\pi}{6}=\frac{\pi}{6}+\frac{1}{2}$

2



3

$f_1(t)=u(t)-u(t-1)$ $\qquad$ $f_2(t)=u(t)-u(t-2)$

$$[u(t)-u(t-1)]*[u(t)-u(t-2)]$$
$$=[tu(t)-(t-1)u(t-1)]*[\delta(t)-\delta(t-2)]$$
$$=tu(t)-(t-1)u(t-1)-(t-2)u(t-2)+(t-3)u(t-3)$$

4

$$\Rightarrow f(-t)\leftrightarrow F(-\omega)$$
$$\Rightarrow -jtf(-t)\leftrightarrow \frac{dF(-\omega)}{d\omega}$$
$$\Rightarrow -tf(-t)\leftrightarrow -j\frac{dF(-\omega)}{d\omega}$$
$$\Rightarrow (1-t)f(1-t)\leftrightarrow -e^{-j\omega}j\frac{dF(-\omega)}{d\omega}$$

5 $\qquad$ $F(0)=\int_{-\infty}^{+\infty}f(t)e^{-j0t}dt=\int_{-\infty}^{+\infty}f(t)dt$，即是 $f(t)$ 围成的面积，由图可得面积为 $\frac{1}{2}*4*2=4$，所以 $F(0)=4$

$$\int_{-\infty}^{+\infty}F(\omega)d\omega=\int_{-\infty}^{+\infty}F(\omega)e^{j\omega 0}d\omega=2\pi f(0)=2\pi$$

6

$$\Rightarrow f(t/a)\leftrightarrow aF(sa)$$
$$\Rightarrow e^{-t/a}f(t/a)\leftrightarrow aF(sa+1)$$

7

$$\frac{1}{s^2-3s+2}=\frac{A_1}{s-1}+\frac{A_2}{s-2}$$

$$A_1=\left.\frac{1}{s-2}\right|_{s=1}=-1$$

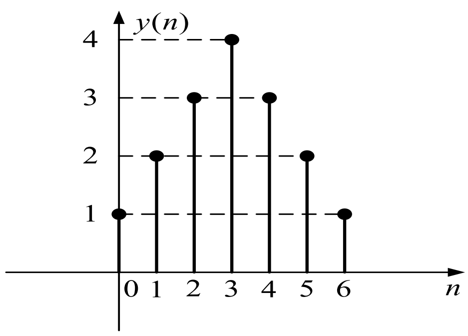
$$A_2=\left.\frac{1}{s-1}\right|_{s=2}=1$$

$$\Rightarrow F^{-1}\left(\frac{1}{s^2-3s+2}\right)=(e^{2t}-e^{t})u(t)$$

$$\Rightarrow F^{-1}\left(\frac{e^{-s}}{s^2-3s+2}\right)=(e^{2(t-1)}-e^{t-1})u(t-1)$$

8

$$h(n)*x(n)=[u(n)-u(n-4)]*[u(n)-u(n-4)]$$
$$=[\delta(n)+\delta(n-1)+\delta(n-2)+\delta(n-3)]*[\delta(n)+\delta(n-1)+\delta(n-2)+\delta(n-3)]$$
$$=\delta(n)+\delta(n-1)+\delta(n-2)+\delta(n-3)$$
$$+\delta(n-1)+\delta(n-2)+\delta(n-3)+\delta(n-4)$$
$$+\delta(n-2)+\delta(n-3)+\delta(n-4)+\delta(n-5)$$
$$+\delta(n-3)+\delta(n-4)+\delta(n-5)+\delta(n-6)$$
$$=\delta(n)+2\delta(n-1)+3\delta(n-2)+4\delta(n-3)+3\delta(n-4)+2\delta(n-5)+\delta(n-6)$$



二

1

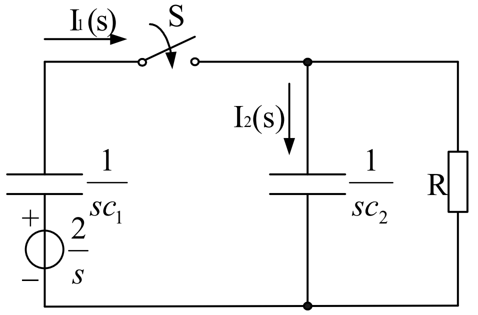
$$f(t)x(t)=(\cos 100t\cos 2000t)*\cos 2000t=\frac{1}{2}\cos 100t(\cos 4000t+1)$$
$$=\frac{1}{4}\cos 3900t+\frac{1}{4}\cos 4100t+\frac{1}{2}\cos 100t$$

$$F\{f(t)x(t)\}=\frac{1}{4}\left[\pi\delta(\omega+3900)+\pi\delta(\omega-3900)\right]+\frac{1}{4}\left[\pi\delta(\omega+4100)+\pi\delta(\omega-4100)\right]$$
$$+\frac{1}{2}\left[\pi\delta(\omega+100)+\pi\delta(\omega-100)\right]$$

$$Y(\omega)=F\{f(t)x(t)\}H(\omega)=\frac{1}{2}\left[\pi\delta(\omega+100)+\pi\delta(\omega-100)\right]$$

$$\therefore y(t)=F^{-1}(Y(\omega))=\frac{1}{2}\cos 100t$$

2



设流经电容 c_2 上的电流为 $I_2(s)$（方向如图所示），可列出 s 域的方程如下：

$$\frac{2}{s}=\frac{1}{sc_1}I_1(s)+\frac{1}{sc_2}I_2(s)$$

$$\frac{1}{sc_2}I_2(s)=R[I_1(s)-I_2(s)]$$

$$\Rightarrow I_2(s)=\frac{sc_2R}{sc_2R+1}$$

$$\Rightarrow I_1(s)=\frac{1+4s}{1+6s}\cdot 2=\frac{4}{3}+\frac{\frac{1}{9}}{s+\frac{1}{6}}$$

$$\Rightarrow i_1(t)=\frac{4}{3}\delta(t)+\frac{1}{9}e^{-\frac{t}{6}}u(t)$$

3

设系统的零输入响应为 $r_{zi}(t)$，激励为 $e(t)$ 时引起的零状态响应为 $r_{zs}(t)$，则利用系统的线性性质有：

$$r_{zi}(t)+r_{zs}(t)=r_1(t)=(e^{-t}+2\cos\pi t)u(t)$$
$$r_{zi}(t)+2r_{zs}(t)=r_2(t)=(3\cos\pi t)u(t)$$
$$\Rightarrow\begin{cases}r_{zs}(t)=(\cos\pi t-e^{-t})u(t)\\ r_{zi}(t)=(\cos\pi t+2e^{-t})u(t)\end{cases}$$

$$\Rightarrow r_3(t)=r_{zi}(t)+3_{zs}r(t-3)=(\cos\pi t+2e^{-t})u(t)+3\{\cos\pi(t-3)-e^{-(t-3)}\}u(t-3)$$

4

由$\frac{d^2r(t)}{dt^2}+3\frac{dr(t)}{dt}+2r(t)=\frac{de(t)}{dt}+3e(t)$，知：

系统的特征方程$\lambda^2+3\lambda+2=0$，$\therefore \lambda_1=-1,\lambda_2=-2$

可设$r_{zi}(t)=A_1e^{-t}+A_2e^{-2t}$，由$r(0_-)=1,r^{/}(0_-)=2$，得：

$$\begin{aligned}&A_1+A_2=1\\&-A_1-2A_2=2\end{aligned}\Rightarrow A_1=4,A_2=-3$$

$$\therefore r_{zi}(t)=[4e^{-t}-3e^{-2t}]u(t)$$

对$\frac{d^2r(t)}{dt^2}+3\frac{dr(t)}{dt}+2r(t)=\frac{de(t)}{dt}+3e(t)$取零状态下的拉氏变换，得：

$$s^2R_{zs}(s)+3sR_{zs}(s)+2R_{zs}(s)=(s+3)E(s)$$

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

$$e(t)=u(t)\Rightarrow E(s)=\frac{1}{s}$$

$$\Rightarrow R_{zs}(s)=\frac{s+3}{s(s^2+3s+2)}=\frac{A_1}{s}+\frac{A_2}{s+1}+\frac{A_3}{s+2}$$

$$A_1=\left.\frac{s+3}{(s+1)(s+2)}\right|_{s=0}=\frac{3}{2}$$

$$A_2=\left.\frac{s+3}{s(s+2)}\right|_{s=-1}=-2$$

$$A_3=\left.\frac{s+3}{s(s+1)}\right|_{s=-2}=\frac{1}{2}$$

$$\therefore R_{zs}(s)=\frac{\frac{3}{2}}{s}+\frac{-2}{s+1}+\frac{\frac{1}{2}}{s+2}$$

$$\therefore r_{zs}(t)=[\frac{3}{2}-2e^{-t}+\frac{1}{2}e^{-2t}]u(t)$$

$$\therefore r(t)=r_{zi}(t)+r_{zs}(t)=(\frac{3}{2}+2e^{-t}-\frac{5}{2}e^{-2t})u(t)$$

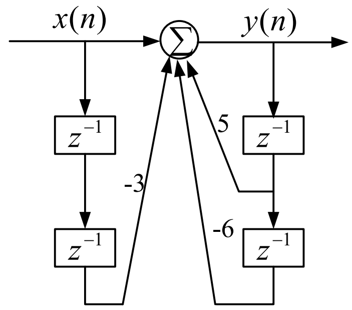
由$H(s)=\frac{s+3}{s^2+3s+2}$知：其极点为$z_1=-1,z_2=-2$，均位于S平面的左半平面，因此系统是稳定的。

其中，自由响应由系统的极点决定，为$(2e^{-t}-\frac{5}{2}e^{-2t})u(t)$，强迫响应由激励决定，

对应特解，为$\frac{3}{2}u(t)$。

5

1 框图如下：



2 对 $y(n)-5y(n-1)+6y(n-2)=x(n)-3x(n-2)$ 取零状态下的 Z 变换，得：

$$Y_{zs}(z)-5z^{-1}Y_{zs}(z)+6z^{-2}Y_{zs}(z)=X(z)-3z^{-2}X(z)$$

$$\Rightarrow H(z)=\frac{z^2-3}{z^2-5z+6}$$

$$\Rightarrow \frac{H(z)}{z}=\frac{z^2-3}{z(z^2-5z+6)}=\frac{A_1}{z}+\frac{A_2}{z-2}+\frac{A_3}{z-3}$$

$$A_1=\left.\frac{z^2-3}{(z-2)(z-3)}\right|_{z=0}=-\frac{1}{2}$$

$$A_2=\left.\frac{z^2-3}{z(z-3)}\right|_{z=2}=-\frac{1}{2}$$

$$A_3=\left.\frac{z^2-3}{z(z-2)}\right|_{z=3}=2$$

$$\therefore H(z)=-\frac{1}{2}+\frac{-\frac{1}{2}z}{z-2}+\frac{2z}{z-3}$$

$$\therefore h(n)=-\frac{1}{2}\delta(n)+\left[-\frac{1}{2}(2)^n+2\cdot 3^n\right]u(n)$$