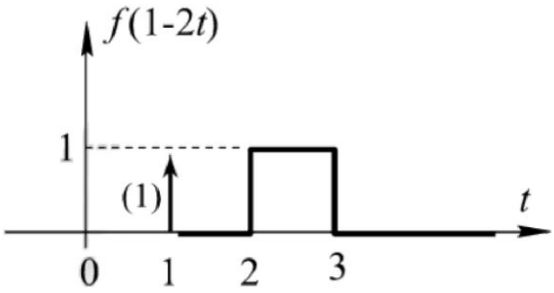
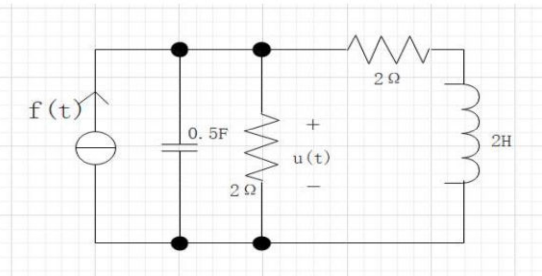
一、计算下列各题。

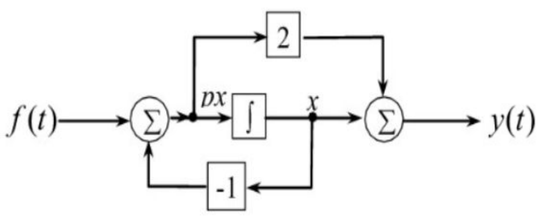
1、已知$f(1-2t)$的图像如图所示，画出$f(t)$的图像，并写出表达式。



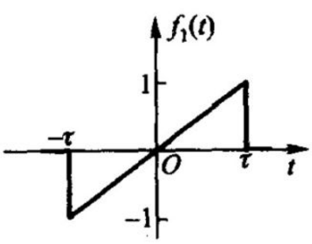
2、图示电路，求$u(t)$对$f(t)$的传输算子$H(p)$。



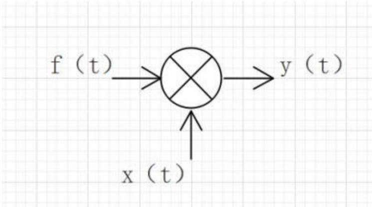
3、求图示系统的阶跃响应$g(t)$



4、利用时域微积分的性质，求图示信号的频谱$F(j\omega)$。



5、图示系统，已知$f(t)=e^{-j2t}\varepsilon(t), x(t)=\cos 20t$, 试求F(j$\omega$),X(j$\omega$)和Y（j$\omega$）



6、设初始状态为零，用拉普拉斯变换解微分方程。

$$x''(t)+2x'(t)+x(t)=\varepsilon(t)$$

7、已知系统

$$f(t)=\begin{cases}1 & 0<t<2\\ 0 & other\end{cases} \qquad h(t)=\begin{cases}t & 0<t<3\\ 0 & other\end{cases}$$

试求系统零状态输出响应 $y(t)=f(t)*h(t)$ 。

8、已知系统函数H(s)，求出零点、极点，画出零极点分布图，并指出系统的稳定性。

$$H(s)=\frac{s^2-4s+3}{s^2+4s+3}$$

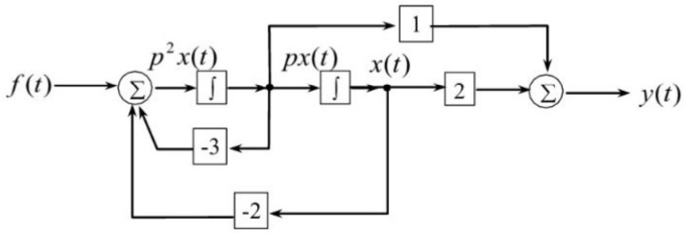
9、设系统特征方程为$6s^5+5s^4+4s^3+3s^2+2s+1=0$，用劳斯判据判定系统稳定性，并写出正实部根的数量。

10、解下列差分方程。

$$\begin{cases}y(k)+3y(k-1)+2y(k-2)=2^k\varepsilon(k)\\ y(0)=0, y(1)=2\end{cases}$$

二、计算下列各题。

1、图示系统，已知激励f(t)=2e^{-2t}$\varepsilon(t)$,求系统的零状态响应$y(t)$。

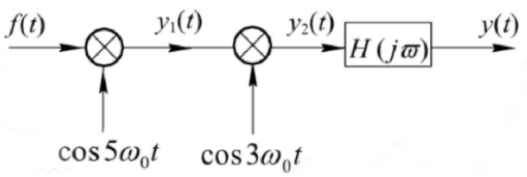


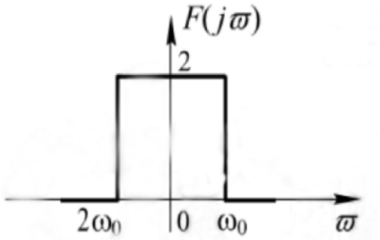
2、图示系统，已知f(t)的频谱函数F(jω)和H(jω)的波形。

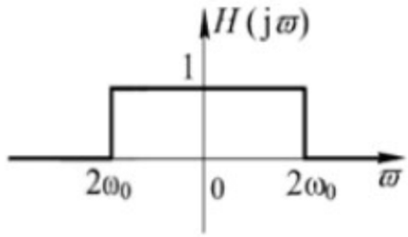
(1)画出y$_1(t)$的频谱Y$_1(j\omega)$

(2)画出y$_2(t)$的频谱Y$_2(j\omega)$

(3)求出y(t)的频谱Y(jω)



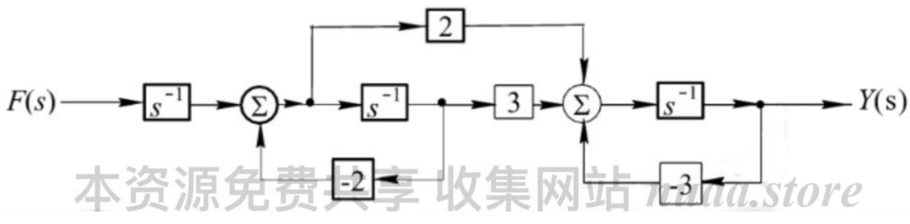




3、某线性系统框图如图所示

(1）求出系统函数H(s)

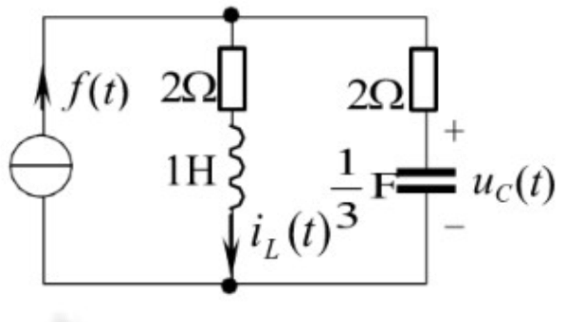
(2）判断系统的稳定性



4、图示电路，f(t)为激励，$u_c(t)$为响应.

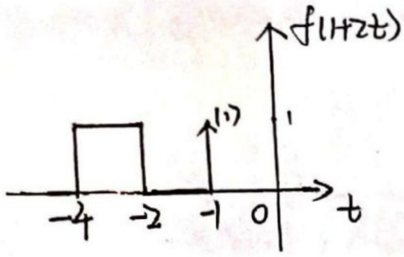
(1)求系统函数$H(s)$

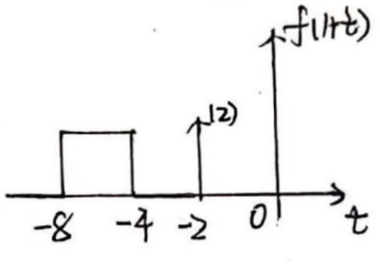
(2)若$f(t)=\varepsilon(t)A, i_L(0_-)=1A, u_c(0_-)$=2V，求零输入响应$u_c(t)$

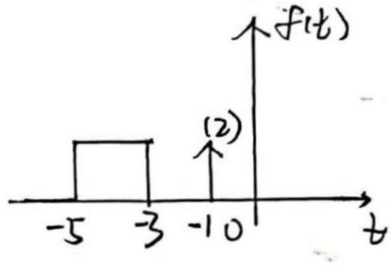


一.

1. 反折. 展缩. 平移.

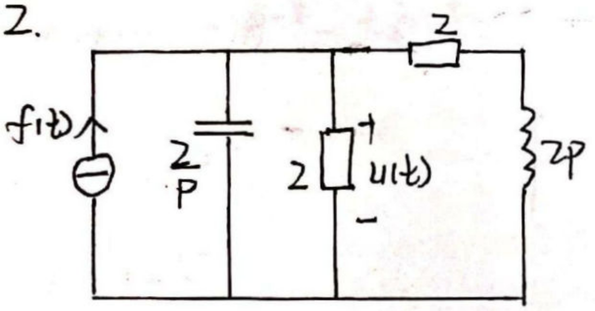






$$f(t) = 2\delta(t+1) + G_4(t+4)$$

2.



$$u(t) = f(t)\cdot \frac{1}{\frac{p}{2}+\frac{1}{2}+\frac{1}{2+2p}} = \frac{2(p+1)}{p^2+2p+2} f(t).$$

3. $\begin{cases} px = f(t) - x \\ y(t) = 2px + x \end{cases}$

$$\Rightarrow y(t) = \frac{2p+1}{p+1} f(t)$$

$$H(p) = \frac{2p+1}{p+1} = 2 - \frac{1}{p+1}$$

$$G(p) = \frac{1}{p} H(p) = \frac{1}{p} + \frac{1}{p+1}$$

$$g(t) = (1+e^{-t})\varepsilon(t)$$

4. $f(t) = \frac{1}{\tau} t\,[\varepsilon(t+\tau) - \varepsilon(t-\tau)]$

$$f'(t) = -\delta(t+\tau) - \delta(t-\tau) + \frac{1}{\tau} G_{2\tau}(t)$$

$$j\omega F(j\omega) = -e^{j\omega\tau} - e^{-j\omega\tau} + \frac{1}{\tau} 2\tau Sa\left(\frac{\omega 2\tau}{2}\right)$$

$$= -2\cos(\omega\tau) + 2Sa(\omega\tau)$$

$$F(j\omega) = \frac{2j}{\omega}[\cos(\omega\tau) - Sa(\omega\tau)].$$

5. $\varepsilon(t) \leftrightarrow \pi\delta(\omega)+\frac{1}{j\omega}$

$F(j\omega)=\pi\delta(\omega+2)+\frac{1}{j(\omega+2)}$

$X(j\omega)=\pi[\delta(\omega+20)+\delta(\omega-20)]$

$Y(j\omega)=\frac{1}{2\pi}F(j\omega)*X(j\omega)$

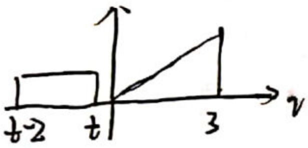
$=\frac{\pi}{2}[\delta(\omega+22)+\delta(\omega-18)]-j\frac{\omega+2}{\omega^2+4\omega-396}$.

6. $s^2X(s)+2sX(s)+X(s)=\frac{1}{s}$

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

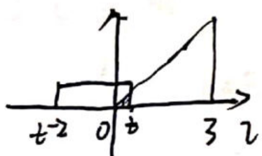
$x(t)=1-e^{-t}-te^{-t}$.

7. ① $t\le 0$



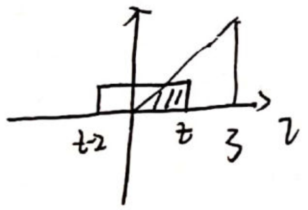
$y(t)=0$.

② $0<t\le 1$



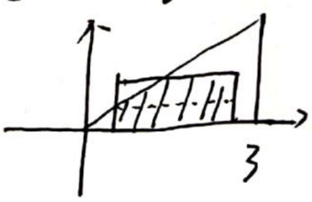
$y(t)=\frac{1}{2}t^2$.

③ $1<t\le 2$.



$y(t)=\frac{1}{2}(t+t-1)\times 1=t-\frac{1}{2}$

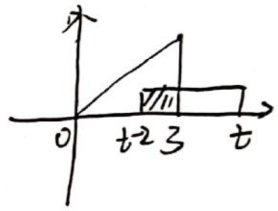
④ $2<t\le 3$



$y(t)=2(t-2)+\frac{1}{2}(t+1)(3-t)$

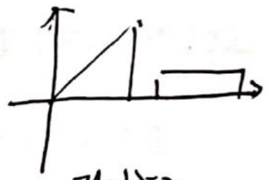
$=-\frac{1}{2}t^2+3t-\frac{5}{2}$

⑤ $3<t\le 5$



$y(t)=5-t$

⑥ $t>5$



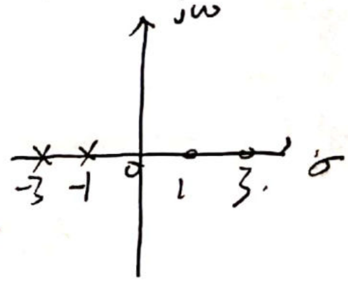
$y(t)=0$.

$$y(t)=\begin{cases}0, & t\le 0\\ \frac{1}{2}t^2, & 0<t\le 1\\ t-\frac{1}{2}, & 1<t\le 2\\ -\frac{1}{2}t^2+3t-\frac{5}{2}, & 2<t\le 3\\ 5-t, & 3<t\le 5\\ 0, & t>5.\end{cases}$$

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

零点 $z_1=1, z_2=3$

极点 $s_1=-1, s_2=-3$



极点均位于左半平面

系统稳定.

9. $6S^5+5S^4+4S^3+3S^2+2S+1=0$

S^5	6	4	2
S^4	5	3	1
S^3	0.4	0.8	
S^2	-7	1	
S^1	$\frac{6}{7}$		
S^0	0		

第一列符号变化 2 次.

系统不稳定

有 2 个正实部根.

~~10. ① 特解.~~

~~$y_d(k)=$~~

10. ① 通解.

$\lambda^2+3\lambda+2=0$

$\lambda_1=-1, \lambda_2=-2$

$y_0(k)=C_1(-1)^k+C_2(-2)^k$

② 特解.

$\lambda=2$ 不为特征根

$y_d(k)=A2^k$

$A2^k+3A2^{k-1}+2A2^{k-2}=2^k$

$\Rightarrow A=\frac{1}{3}$

$y(k)=C_1(-1)^k+C_2(-2)^k+\frac{1}{3}2^k\varepsilon(k)$

代入 $y(0)=0, y(1)=2$

$$\begin{cases} 0=C_1+C_2+\frac{1}{3} \\ 2=-C_1-2C_2+\frac{2}{3} \end{cases} \Rightarrow \begin{cases} C_1=\frac{2}{3} \\ C_2=-1 \end{cases}$$

$y(k)=[\frac{2}{3}(-1)^k-(-2)^k+\frac{1}{3}(2^k)]\varepsilon(k)$

二.

(一) 1.

$$\begin{cases} f(t) = p^2 x(t) + 3p\,x(t) + 2x(t) \\ p\,x(t) + 2x(t) = y(t) \end{cases}$$

$$\Rightarrow y(t) = \frac{1}{p+1} x(t)$$

$$H(p) = \frac{1}{p+1}$$

$$h(t) = e^{-t}\varepsilon(t)$$

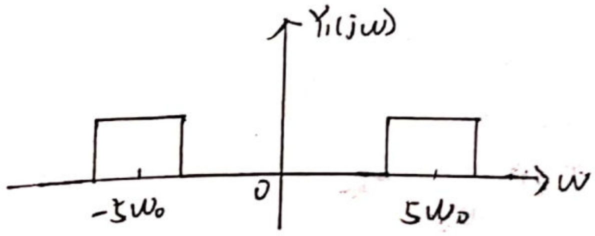
$$y(t) = f(t) * h(t) = 2(e^{-t} - e^{-2t})\varepsilon(t)$$

2.

(1) $\cos 5\omega_0 t \leftrightarrow \pi[\delta(\omega+5\omega_0)+\delta(\omega-5\omega_0)]$

$$Y_1(j\omega) = \frac{1}{2\pi} F(j\omega) * \pi[\delta(\omega+5\omega_0)+\delta(\omega-5\omega_0)]$$

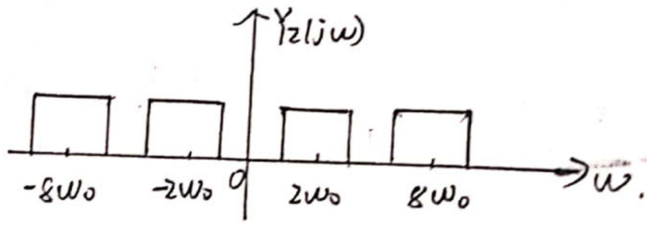
$$= G_{2\omega_0}(\omega+5\omega_0) + G_{2\omega_0}(\omega-5\omega_0)$$



(2) $\cos 3\omega_0 t \leftrightarrow \pi[\delta(\omega+3\omega_0)+\delta(\omega-3\omega_0)]$

$$Y_2(j\omega) = \frac{1}{2\pi} Y_1(j\omega) * \pi[\delta(\omega+3\omega_0)+\delta(\omega-3\omega_0)]$$

$$= \frac{1}{2}[G_{2\omega_0}(\omega+8\omega_0) + G_{2\omega_0}(\omega-2\omega_0) + G_{2\omega_0}(\omega+2\omega_0) + G_{2\omega_0}(\omega-8\omega_0)]$$

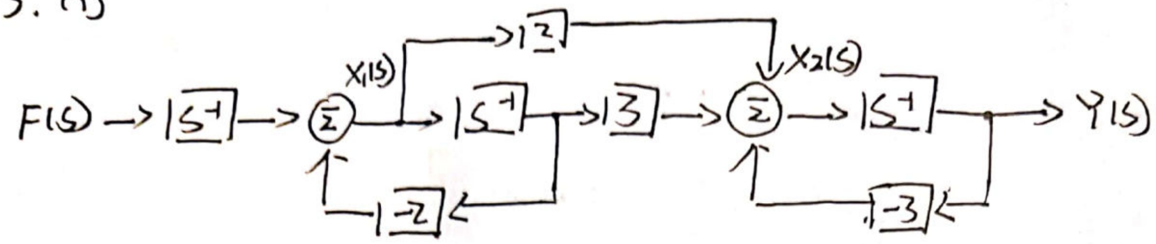


(3) $Y(j\omega) = Y_2(j\omega)H(j\omega)$

$$= \frac{1}{2}[G_{\omega_0}(\omega+1.5\omega_0) + G_{\omega_0}(\omega-1.5\omega_0)]$$

$$y(t) = \frac{\omega_0}{4\pi} Sa\left(\frac{\omega_0 t}{2}\right)(e^{-1.5j\omega_0 t} + e^{1.5j\omega_0 t})$$

3. (1)



$$\begin{cases} X_1(s) = s^{-1}F(s) + s^{-1}X_1(s)\cdot(-2) \\ X_2(s) = 3s^{-1}X_1(s) + 2X_1(s) - 3s^{-1}X_2(s) \\ Y(s) = s^{-1}X_2(s) \end{cases}$$

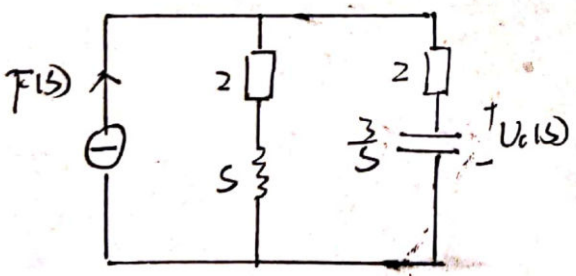
$$\Rightarrow Y(s) = \frac{3s^{-3}+2s^{-2}}{1+5s^{-1}+6s^{-2}}F(s)$$

$$= \frac{2s+3}{s^3+5s^2+6s}F(s)$$

$$H(s) = \frac{2s+3}{s^3+5s^2+6s}.$$

(2) $H(s) = \dfrac{2s+3}{s(s+2)(s+3)}$，极点 $s_1=0, s_2=-2, s_3=-3$：~~稳定~~ 临界稳定.

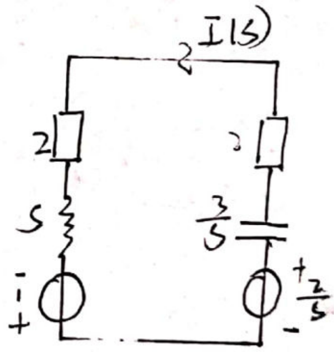
4. (1)



$$U_c(s) = F(s)\cdot\frac{2+s}{2+s+2+\frac{3}{s}}\cdot\frac{3}{s} = \frac{3(s+2)}{s^2+4s+3}F(s)$$

$$H(s) = \frac{3(s+2)}{s^2+4s+3}.$$

(2)



$$\begin{cases} I(s) = \dfrac{1-\frac{2}{s}}{s+2+2+\frac{3}{s}} \\ U(s) = -I(s)\cdot\frac{3}{s}+\frac{2}{s} \end{cases}$$

$$\Rightarrow U_c(s) = \frac{2s+5}{(s+1)(s+3)} = \frac{1.5}{s+1}+\frac{0.5}{s+3}$$

$$u_c(t) = (1.5e^{-t}+0.5e^{-3t})\,V.$$