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第9章 2,5,7,8,9,13,21(abij),22(a,b,c),28,31,32,33,34,35.

2. (a). $X(s)=\int_{-\infty}^{+\infty}x(t)e^{-st}\,dt$

$=\int_{1}^{+\infty}e^{-(s+5)t}\,dt$

$=-\frac{1}{s+5}e^{-(s+5)t}\Big|_{1}^{+\infty}$

$=\frac{e^{-(s+5)}}{s+5}$, $Re(s)>-5$.

(b) $G(s)=\int_{-\infty}^{-t_0}Ae^{-5t}e^{-st}\,dt$

$=\frac{A}{s+5}e^{(s+5)t}\Big|_{t=t_0}$

$\therefore A=1$ $t_0=-1$.

收敛域为 $Re(s)<-5$.

5. (a) 在s平面有零点，$s=-2$.

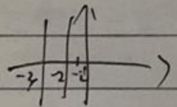
在无限远有一个零点

(b)在s平面无零点

在无限远点有一零点

(c). 在s平面有一零点 $s=1$

在无限远点无零点

7. 

$s^2+s+1=0$.

$s^2+s+\frac{1}{4}=-\frac{3}{4}$

$s=-\frac{1}{2}\pm\frac{3}{4}j$

∴有4个信号.

8. $g(t)=x(t)e^{2t}$ $G(s)=X(s-2)$

~~$x(t)=g(t)e^{-2t}$~~

~~∵g(t)收敛~~

~~∴在 X(s) 的收敛域内~~

~~∴x(t)是右边信号~~

∵G(s)有两极点 -1和1.

∵ $G(j\omega)$ 收敛

∴0在收敛域内

∴g(t)是双边信号

∴x(t)是双边信号

9、$X(s) = \frac{2(s+2)}{(s+3)(s+4)}$.

$= 2\left(\frac{2}{s+4} - \frac{1}{s+3}\right)$

$Re\{s\} > -3$ ∴ $x(t)$是右边信号.

∴ $x(t) = 4e^{-4t}u(t) - 2e^{-3t}u(t)$.

13. $g(t)$有两极点 1和 −1，一零点 $s=0$.

$g(t) = x(t) + \alpha x(-t)$,

$x(t) = \beta e^{-t}u(t)$,

$x(-t) = \beta e^{t}u(-t)$.

∴ $g(t) = \beta e^{-t}u(t) + \alpha\beta e^{t}u(-t)$.

$G(s) = \frac{1}{2}\frac{1}{s+1} + \frac{1}{2}\frac{1}{s-1}$.

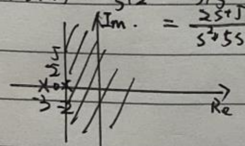
$e^{-t}u(t)$ 的 Laplace transform 为 $\frac{1}{s+1}$，$Re\{s\} > -1$.

$e^{t}u(-t)$ 的 Laplace transform 为 $-\frac{1}{s-1}$，$Re\{s\} < 1$.

∴ $\alpha = -1$，$\beta = \frac{1}{2}$.

21. (a). $X(s) = \frac{1}{s+2} + \frac{1}{s+3}$，$Re\{s\} > -2$

$= \frac{2s+5}{s^2+5s+6}$



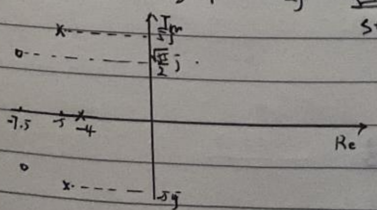
(b). $x(t) = e^{-4t}u(t) + e^{-5t}(\sin 5t)u(t)$

由欧拉公式得

$x(t) = e^{-4t}u(t) + \frac{1}{2j}\left(e^{-5t+j5t} - e^{-5t-j5t}\right)u(t)$.

∴ $X(s) = \frac{1}{s+4} + \frac{1}{2j}\left(\frac{1}{s+5-5j} - \frac{1}{s+5+5j}\right)$ ~~$Re\{s\} > -4$~~

$= \frac{1}{s+4} + \frac{5}{(s+5)^2+25}$，$Re\{s\} > -4$.



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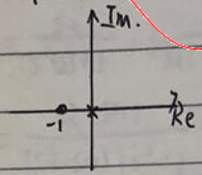
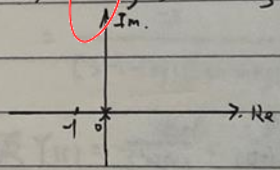
(i). $x(t) = \delta(t) + u(t)$

$X(s) = 1 + \frac{1}{s} \quad Re\{s\} > 0.$



(j). $x(t) = \delta(3t) + u(3t)$

$X(s) = 1 + \frac{1}{3} \times \frac{3}{s} = 1 + \frac{1}{s}, \ Re\{s\} > 0.$



22, (a) $\because \sin 3t \ u(t) \xleftrightarrow{L} \frac{3}{s^2+9}, \ Re\{s\} > 0$

$\therefore \frac{1}{3} \sin 3t \ u(t) \xleftrightarrow{L} \frac{1}{s^2+9}, \ Re\{s\} > 0.$

$\therefore x(t) = \frac{1}{3} \sin 3t \ u(t).$

(b). $\because \cos 3t \ u(t) \xleftrightarrow{L} \frac{s}{s^2+9}, \ Re\{s\} > 0$

$\therefore \cos -3t \ u(t) \xleftrightarrow{L} -\frac{s}{s^2+9}, \ Re\{s\} < 0.$

$\therefore x(t) = -\cos 3t \ u(t).$

(c). ~~x(t)~~ 由s域平移性质得

$x(t) = -e^{-t} \cos 3t \ u(-t)$

28. (a) $Re\{s\} < -2.$

$-2 < Re\{s\} < -1.$

$-1 < Re\{s\} < 1$

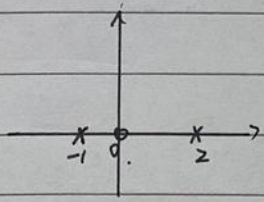
$Re\{s\} > 1.$

~~$Re\{s\} > 2$~~

(b). 对于 $Re\{s\} > 1$. 有关系统是因果的 其他 是非因果的.

对于 $Re\{s\} < 1$. 有关系统是稳定的 其他是不稳定的

31、(a) $H(s) = \frac{1}{s^2-s-2}$.



(b) (i) ∵ 系统是稳定的,

∴ 收敛域包括 $j\omega$ 轴.

∴ 收敛域为 $-1 < Re\{s\} < 2$.

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

∴ $h(t) = -\frac{1}{3}e^{-t}u(t) - \frac{1}{3}e^{2t}u(-t)$.

(ii) ∵ 系统是因果的

∴ 收敛域为 $Re\{s\} > 2$.

∴ $h(t) = -\frac{1}{3}e^{-t}u(t) + \frac{1}{3}e^{2t}u(t)$.

(iii) ∵ 系统既不稳定又不因果

∴ 收敛域为 $Re\{s\} < -1$.

∴ $h(t) = \frac{1}{3}e^{-t}u(-t) - \frac{1}{3}e^{2t}u(-t)$.

32、 $x(t) = e^{2t}$ 时, $y(t) = \frac{1}{6}e^{2t}$.

∴ $H(2) = \frac{1}{6}$.

$sH(s) + 2H(s) = \frac{1}{s+4} + \frac{b}{s}$. $Re\{s\} > 0$.

$4H(2) = \frac{2}{3} = \frac{1}{6} + \frac{b}{2}$

$\Rightarrow b = 1$.

∴ $H(s) = \frac{2}{s(s+4)}$, $Re\{s\} > 0$.

33、

33、$x(t) = e^{-t}u(t) + e^{t}u(-t)$

$\therefore X(s) = \frac{1}{s+1} - \frac{1}{s-1}$, $-1 < Re\{s\} < 1$.

$\therefore Y(s) = \frac{s+1}{s^2+2s+2} \cdot (\frac{1}{s+1} - \frac{1}{s-1})$

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

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

$= \frac{-2}{[s-(-1+j)][s-(-1-j)](s-1)}$, $-1 < Re\{s\} < 1$

设 $Y(s) = \frac{As+B}{s^2+2s+2} + \frac{C}{s-1}$

$\therefore As^2 - As + Bs - B + Cs^2 + 2Cs + 2C = -2$

$\Rightarrow C = -\frac{2}{5}$ $A = \frac{2}{5}$ $B = \frac{6}{5}$

$\therefore Y(s) = \frac{2}{5} \cdot \frac{s+3}{s^2+s+2} - \frac{2}{5} \frac{1}{s-1}$

$= \frac{2}{5} \frac{s+1}{(s+1)^2+1} + \frac{4}{5} \frac{1}{(s+1)^2+1} - \frac{2}{5} \frac{1}{s-1}$, $-1 < Re\{s\} < 1$

$\therefore y(t) = \frac{2}{5} e^{-t}\cos t\ u(t) + \frac{4}{5} e^{-t} \sin t\ u(t) + \frac{2}{5} e^{t} u(-t)$

34. $\because H(s)$ 因果稳定，

$\therefore$ 收敛域包括 $j\omega$ 轴且为右边信号.

~~$\frac{1}{s} H(s)$~~

输入为 $u(t)$ 时 $X(s) = \frac{1}{s}$ $Re\{s\} > 0$.

$\because \frac{1}{s} H(s)$ 绝对可积，

$\therefore H(0) = 0$.

输入为 $tu(t)$ 时 $X(s) = \frac{1}{s^2}$ $Re\{s\} > 0$

$\because \frac{1}{s^2} H(s)$ 不绝对可积，

$\therefore$ 零点不是二次项.

设 $Y(s) = s^2 H(s) + 2sH(s) + 2H(s)$

$\therefore H(s) = \frac{Y(s)}{s^2+2s+2}$

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∵ $Y(s)$ 是有限持续期且绝对可积

∴ $Y(s)$ 的收敛域是整个 s平面.

~~∵ $H(1) = 0.2$~~

~~$Y(1) = 1$~~

∴ $Y(s)$ 没有极点 只有零点

∵ $H(s)$ 有一个零点 且 $H(1) = 0.2$

∴ $H(s) = \frac{s}{s^2+2s+2}$, $Re\{s\} > -1$.

3. (a) $\frac{Y(s)}{X(s)} = \frac{s^2-s-6}{s^2+2s+1}$.

∴ 微分方程为 $y''(t) + 2y'(t) + y(t) = x''(t) - x'(t) - 6x(t)$

(b) ∵ 该系统是因果的.

极点为 $Re\{s\} = -1 < 0$

∴ 该系统是稳定的.

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