周子涵 2018011218014

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

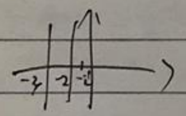
(b)在s平面无零点

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.



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

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

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

$\therefore$有4个信号.

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

~~$x(t)=g(t)e^{-2t}$~~ $\therefore G(s)$有两极点-1和1.

~~$\because g(t)$收敛~~ $\because G(j\omega)$收敛

$\therefore$ ~~0在$X(s)$的收敛域内~~ $\therefore$ 0在收敛域内

$\therefore$ ~~$x(t)$是右边信号~~ $\therefore$ $g(t)$是双边信号

$\therefore x(t)$是双边信号

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9、$X(s) = \dfrac{2(s+2)}{(s+3)(s+4)}$.

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

$Re\{s\} > -3$ ∴ 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.

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

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

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

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

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

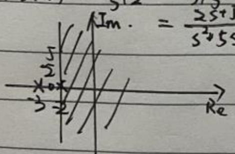
$e^{-t}u(t)$ 的 Laplace transform 为 $\dfrac{1}{s+1}$. $Re\{s\} > -1$.

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

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

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

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



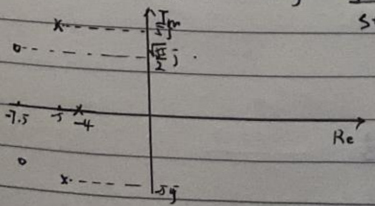
(b). $x(t) = e^{-4t}u(t) + e^{-5t}(\sin 5t)u(t)$

由欧拉公式得

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

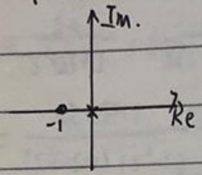
∴ $X(s) = \dfrac{1}{s+4} + \dfrac{1}{2j}\left(\dfrac{1}{\cancel{s+5j+5}\ s+5-5j} - \dfrac{1}{s+5+5j}\right)$. ~~Re{s} > -4~~.

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



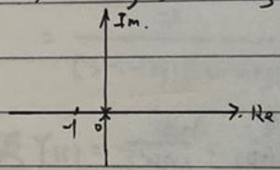
(i). $x(t)=\delta(t)+u(t)$

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



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

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



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

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

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

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

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

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

(c). 由s域平移性质得

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

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

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

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

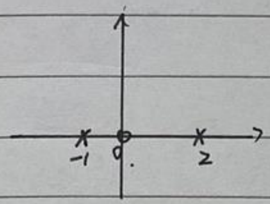
$\mathrm{Re}\{s\}>1$.

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

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

对于 $-1<\mathrm{Re}\{s\}<1$. 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. $x(t) = e^{-t}u(t) + e^{t}u(-t)$.

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

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

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

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

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

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.

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

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 $Y(s) = s^2H(s) + 2sH(s) + 2H(s)$

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

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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$H(1)=0.2$.

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

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

∴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.