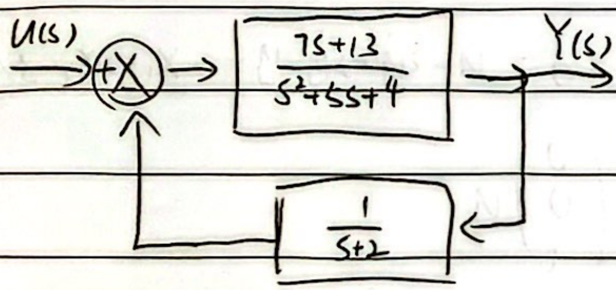
10.10

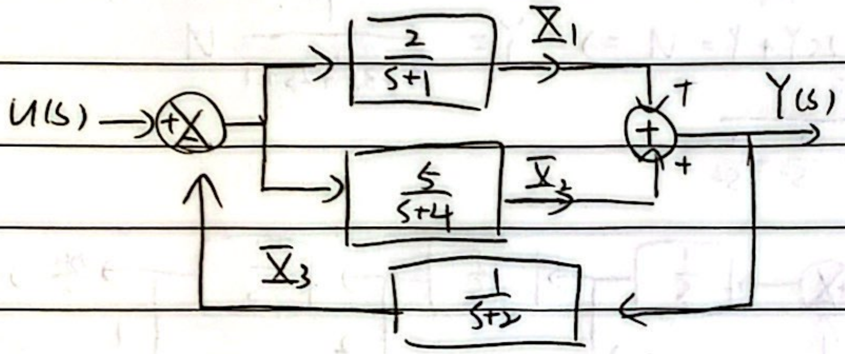
1.




~~U(s)~~

=)

$$\frac{7s+13}{s^2+5s+4} = \frac{7s+13}{(s+1)(s+4)} = \frac{2}{s+1} + \frac{5}{s+4}$$




$\therefore Y = \bar{X}_1 + \bar{X}_2$, $\bar{X}_1 = (U - \bar{X}_3)\frac{2}{s+1}$, $\bar{X}_2 = (U - \bar{X}_3)\frac{5}{s+4}$

$\bar{X}_3 = (\bar{X}_1 + \bar{X}_2)\frac{1}{s+2}$

$$\therefore \begin{cases} s\bar{X}_1 = -\bar{X}_1 - 2\bar{X}_3 + 2U \\ s\bar{X}_2 = -4\bar{X}_2 - 5\bar{X}_3 + 5U \\ s\bar{X}_3 = \bar{X}_1 + \bar{X}_2 - 2\bar{X}_3 \end{cases} \Rightarrow \begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{pmatrix} = \begin{pmatrix} -1 & 0 & -2 \\ 0 & -4 & -5 \\ 1 & 1 & -2 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} + \begin{pmatrix} 2 \\ 5 \\ 0 \end{pmatrix} u$$

$$y = x_1 + x_2 \Rightarrow y = (1, 1, 0)\begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} + 0 \cdot u$$

2、 $\dddot{y}+3\ddot{y}+2\dot{y}+y=u$.

令 $x_1=y,\ x_2=\dot{y},\ x_3=\ddot{y}$

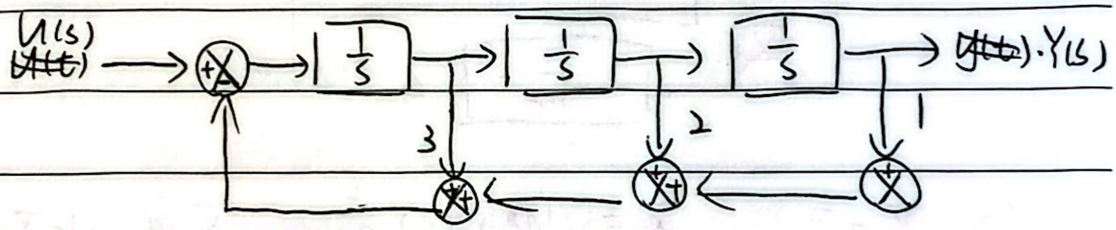
∴ $\dot{x}_1=\dot{y}=x_2,\quad \dot{x}_2=\ddot{y}=x_3,\quad \dot{x}_3=\dddot{y}=u-3\ddot{y}-2\dot{y}-y=-x_1-2x_2-3x_3+u$.

∴ $$\begin{pmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{pmatrix}=\begin{pmatrix}0&1&0\\0&0&1\\-1&-2&-3\end{pmatrix}\begin{pmatrix}x_1\\x_2\\x_3\end{pmatrix}+\begin{pmatrix}0\\0\\1\end{pmatrix}u$$

$$y=(1,0,0)\begin{pmatrix}x_1\\x_2\\x_3\end{pmatrix}+0\cdot u$$

对 ZS, $s^3Y+3s^2Y+2sY+Y=U \Rightarrow Y=\frac{1}{s^3+3s^2+2s+1}U$

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

∴ 


3、

$$\begin{pmatrix}\dot{x}_1\\ \dot{x}_2\end{pmatrix}=\begin{pmatrix}-4&-1\\3&-1\end{pmatrix}\begin{pmatrix}x_1\\x_2\end{pmatrix}+\begin{pmatrix}1\\-1\end{pmatrix}u,\quad y=(2,1)\begin{pmatrix}x_1\\x_2\end{pmatrix}+0\cdot u.$$

$$A=\begin{pmatrix}-4&-1\\3&-1\end{pmatrix},\ B=\begin{pmatrix}1\\-1\end{pmatrix}\quad C=(2,1),\quad D=0_{1\times1}$$

$\dot{x}=Ax+Bu,\ y=Cx+Du \Rightarrow$ ~~(I-A)x~~ $sX=AX+BU,\ Y=CX+DU$.

$\Rightarrow (Is-A)X=BU \Rightarrow X=(Is-A)^{-1}BU \Rightarrow Y=[C[Is-A]^{-1}B+D$

∴ $G(s)=[C(Is-A)^{-1}B+D]$

$$=\frac{s+3}{(s+1)(s+4)+3}.$$