一.

1. $1-G(s)H(s)=0$

2 超前

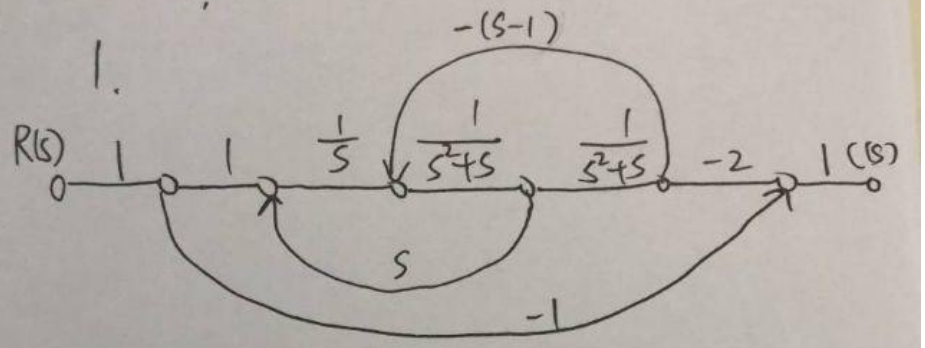
3 准确性.

4 $\frac{15.36}{s^2+25+2}$

5 $\frac{1}{2}$

二、

1.



回路：$L_1: \frac{S}{S(S^2+S)}$

$L_2: -\frac{S-1}{(S^2+S)^2}$

$L_3: \frac{2}{S(S^2+S)^2}$

前向通路：$P_1: \frac{-2}{S(S^2+S)^2}$ $\Delta_1 = 1$

$$\frac{C(S)}{R(S)} = \frac{-2}{-S(S^2+S)^2+S(S-1)-S(S^2+S)+2}$$

$$= \frac{-2}{-S^5-2S^4-S^3+S^2-S-S^3-S^2+2}$$

L_3: $\frac{2}{s(s^2+s)^2}$

前向通路: P_1: $\frac{-2}{s(s^2+s)^2}$ $\Delta_1=1$

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

$$=\frac{-2}{-s^5-2s^4-s^3+s^2-s-s^3-s^2+2}$$

$$=\frac{-2}{-s^5-2s^4-2s^3-s+2}$$

$D(s)=-s^5-2s^4-2s^3-s+2$

s^5	-1	-2	-1
s^4	-2	0	2
s^3	-2	-2	
s^2	2	2	
s^1	0		
s^1	4		
s^0	2		

首列符号不全大于0

故不稳

有2个根在s平面右半部分

令 $D(s)=2s^2+2$

$\frac{dD(s)}{ds}=4s$

三.

由 $\frac{U_o(s)}{U_i(s)} = -\frac{\frac{R_2}{Cs}}{R_2+\frac{1}{Cs}}$

R_1

$= -\frac{\frac{R_2}{R_2Cs+1}}{R_1}$

$= -\frac{R_2}{R_1R_2Cs+R_1}$

$R_1R_2C\frac{du_o(t)}{dt} + R_1\frac{du_o(t)}{dt} + R_2u_i(t) = 0$

III.

1. $D(s)=s^3+s^2+\frac{1}{4}s+\frac{1}{4}a$

$$=\frac{\frac{1}{4}a}{s(s+\frac{1}{2})^2}+1$$

令 $G_1(s)=\frac{\frac{1}{4}a}{s(s+\frac{1}{2})^2}$

开环极点: $p_1=0$ $p_2=p_3=-\frac{1}{2}$

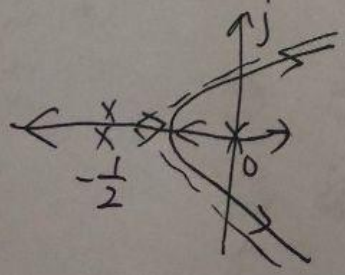
无开环零点.

实轴: $(-\infty,0]$

渐近线: $\begin{cases}\sigma_a=\frac{0-\frac{1}{2}-\frac{1}{2}}{3}=-\frac{1}{3}\\ \varphi_a=\frac{\pm(2k+1)\pi}{3}=\pm 60^\circ,180^\circ\end{cases}$

分离点: $3s^2+2s+\frac{1}{4}=0 \Rightarrow s_1=-0.167$

与虚轴交点: $\begin{cases}-\omega^3+\frac{1}{4}\omega=0\\ -\omega^2+\frac{1}{4}a=0\end{cases}\Rightarrow\begin{cases}\omega^2=\frac{1}{4}\\ a=1\end{cases}$



(2) $\xi=1$ 时, $a=1$

$$\Phi(s)=\frac{\frac{1}{4}}{s^3+s^2+\frac{1}{4}s+\frac{1}{4}}$$

五. (1) $\Phi(s)=\frac{9}{4s^2+8s+9}$ $\begin{cases}2\zeta\omega_n=2\\ \omega_n^2=1.25\end{cases}$

$$C(s)=\frac{9}{s(4s^2+8s+9)}=\frac{1}{s}-\frac{4s+8}{4s^2+8s+9}$$

$$=\frac{1}{s}-\frac{s+2}{s^2+2s+2.25}=\frac{1}{s}-\frac{s+1+1}{(s+1)^2+1.25}$$

$$C(t)=1-e^{-t}\cos 1.12t-0.89e^{-t}\sin 1.12t$$

(2) $M_p=e^{\frac{-\pi\zeta}{\sqrt{1-\zeta^2}}}\times 100\%=0.2[illegible]\%$

$$t_s=\frac{3.5}{\zeta\omega_n}=3.5$$

$$\Rightarrow \zeta=0.89$$
$$\omega_n=1.12$$

十一.

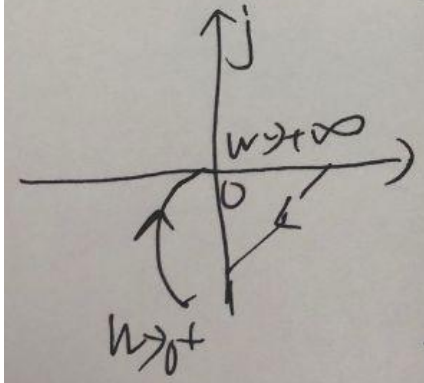
$$G_{1K}(s)=\frac{K}{s(s+1)}$$

$$\varphi(w)=-90^\circ-\arctan w$$

$$A(w)=\frac{K}{w\sqrt{w^2+1}}$$

$w\to 0^+$ $\varphi(w)=-90^\circ$

$w\to+\infty$ $\varphi(w)=-180^\circ$



$N_+=N_-=0$

$Z=P-2N=0-0$

$=0$

故稳定

十二. $D(s)=s^2+s+K$ $\Rightarrow K>0$. 稳定

t.

$$G(s) = \frac{k\left(\frac{1}{w_1}s+1\right)}{s^2\left(\frac{1}{w_2}s+1\right)} \qquad v=2$$

$$k^{\frac{1}{v}} = 10 \Rightarrow k = 100$$

$$\frac{0-20}{\lg 10 - \lg w_1} = -40 \Rightarrow w_1 = 3.16$$

$$\frac{-10-20}{\lg w_2 - \lg w_1} = -20 \Rightarrow w_2 = 100$$

$$G(s) = \frac{100\left(\frac{1}{3.16}s+1\right)}{s^2\left(\frac{1}{100}s+1\right)}$$

11

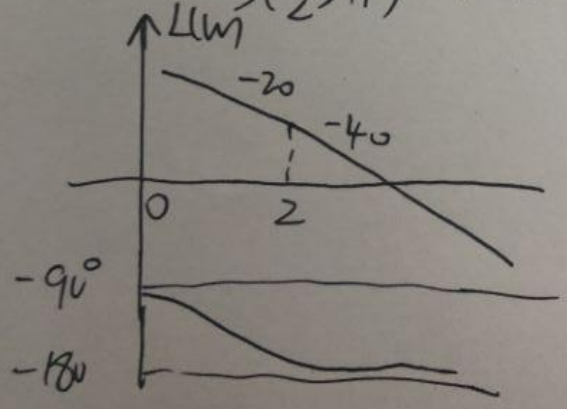
1. $G_K(s) = \frac{4k}{s(s+2)}$

$k_v = \lim_{s \to 0} s \cdot G_K(s) = 2k$

$e_{ss} = \frac{1}{k_v} = \frac{1}{2k} = 0.05$

$\Rightarrow k = 100$

$G_K(s) = \frac{200}{s(\frac{1}{2}s+1)}$ $|G_K(j\omega)| = 1 \Rightarrow \omega_c = 20$



2. $\gamma = 180° - 90° - \arctan\frac{1}{2}\omega_c = 51.7°$

$-90° - \arctan\frac{1}{2}\omega_g = \pm(2k+1)\pi \Rightarrow \omega_g = 0$

$K_g = \frac{1}{|G(j\omega_g)|} = \infty$

3. $\varphi_m = 45° - 51.7° + 51.7° = 45°$

$\alpha = \frac{1+\sin\varphi_m}{1-\sin\varphi_m} = 5.8$

$10\lg\alpha = 40\lg\frac{\omega_m}{\omega_c} \Rightarrow \omega_m = 31$

$T = \frac{1}{\sqrt{\alpha}\omega_m} = 0.013$

$G_c(s) = \frac{1+0.078s}{1+0.013s}$