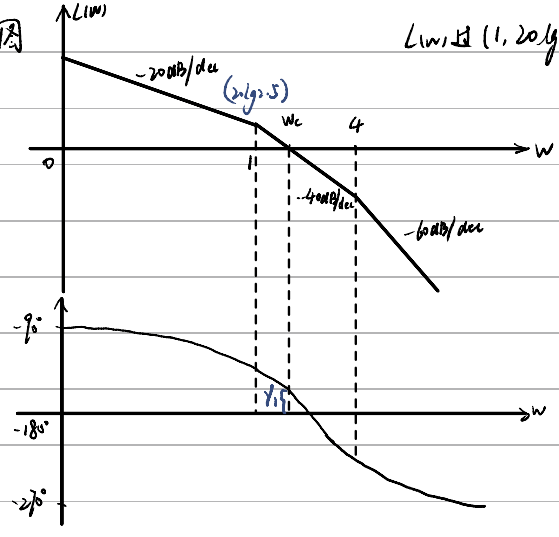
7.3 解: (1) $G(s)=\frac{2.5}{s(1+s)(1+0.25s)}$ $G(jw)=\frac{2.5}{jw(1+jw)(1+0.25jw)}$

环节	转折频率	斜率	累计斜率
2.5	/	0	0
$\frac{1}{s}$	/	-20	-20
$\frac{1}{1+s}$	1	-20	-40
$\frac{1}{1+0.25s}$	4	-20	-60

$L(w)=20\lg 2.5-20\lg w-20\lg\sqrt{w^2+1}-20\lg\sqrt{1+(0.25w)^2}$

$\varphi(w)=-\frac{\pi}{2}-\arctan w-\arctan 0.25w$

作为渐近图



$L(w)$ 过 $(1, 20\lg 2.5)$

用斜率计算 $40(\lg w_c-\lg 1)=20\lg 2.5=7.96\,dB \Rightarrow w_c=1.58\,rad/s$

求 $\gamma_1=180°+\varphi(w_c)=180°+\varphi(1.58)=10.8°$

因此 $\varphi_m=\gamma_2-\gamma_1+(5°\sim 12°)$ 选择 8° 为裕度 $\varphi_m=40°-10.8°+8°=37.2°$

$\alpha=\frac{1+\sin\varphi_m}{1-\sin\varphi_m}=4.06$

确定校正后的幅值穿越频率 $L(w_{c2})=-10\lg\alpha$

即 $20\lg 2.5 - 20\lg \omega_{c_2} - 20\lg\sqrt{1+\omega_{c_2}^2} - 20\lg\sqrt{1+(0.25\omega_{c_2})^2} = -10\lg 4.06$

解得 $\omega_{c_2} \approx 2\ rad/s$　　故 $\omega_m = \omega_{c_2} = 2\ rad/s$

因此 $T = \frac{1}{\sqrt{\alpha}\omega_m} = 0.25$

故 $G_c(s) = \frac{1+\alpha Ts}{1+Ts} = \frac{1+1.0155}{1+0.25s}$

综上：校正后的传递函为 $G_1(s) = G_c(s)\cdot G(s)$

$$= \frac{2.5(1+1.0155)}{s(1+s)(1+0.25s)^2}$$