

### 1. 如何表示传递函数对应的频率特性

$$G(s) = \frac{K}{s(0.1s+1)(0.001s+1)} \quad -T \rightarrow 90^\circ$$

$$G(s) = \frac{40(s+0.5)}{s(s+0.2)(s^2+s+1)}$$

$$① G(j\omega) = \frac{K}{j\omega(0.1j\omega+1)(0.001j\omega+1)}$$

幅:  $\frac{K}{\omega \cdot \sqrt{1+(0.1\omega)^2} \cdot \sqrt{1+(0.001\omega)^2}}$

相:  $0 - 90^\circ - \arctan \frac{0.1\omega}{1} - \arctan \frac{0.001\omega}{1}$   
 $\rightarrow -90^\circ - \arctan 0.1\omega - \arctan 0.001\omega$

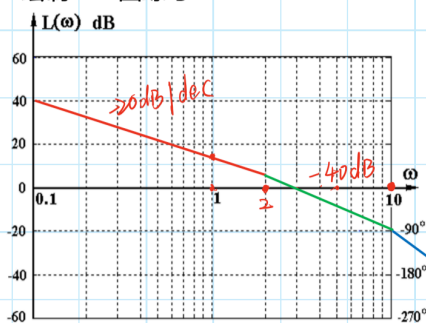
$$② G(j\omega) = \frac{40(j\omega+0.5)}{j\omega(j\omega+0.2)(1-\omega^2+j\omega)}$$

$$s^2+s+1 = (j\omega)^2+j\omega+1 = -\omega^2+j\omega+1 = 1-\omega^2+j\omega$$

幅:  $\frac{40\sqrt{0.5^2+\omega^2}}{\omega \cdot \sqrt{0.2^2+\omega^2} \cdot \sqrt{(1-\omega^2)^2+\omega^2}}$

相:  $\arctan \frac{\omega}{0.5} - \arctan \frac{\omega}{0.2} - \arctan \frac{\omega}{1-\omega^2} - 90^\circ$

### 3. 绘制bode图练习



① 增益线:  $20\lg 5 = 14 \text{ dB}$  (总),  $14 \text{ dB}$   
 $-20 \text{ dB}$

②  $\omega_1 = 2 \quad -20 \text{ dB}$   
 $\omega_2 = 10 \quad -20 \text{ dB}$

$-60 \text{ dB}$

$$G(s) = \frac{5}{s(\frac{s}{2}+1)(\frac{s}{10}+1)}$$

### 2. 如何不绘制bode图, 只根据公式近似求 $\omega_c$

$$G(s) = \frac{5}{s(\frac{s}{2}+1)(\frac{s}{10}+1)}$$

①  $|G(j\omega_0)| = 1 \rightarrow 20\lg |G(j\omega_0)| = 0$  交点

②  $\omega < 2$   $\frac{5}{\omega \cdot 1 \cdot 1} = 1 \Rightarrow \omega = 5$  不符合假设

$2 < \omega < 10$   $\frac{5}{\omega \cdot \frac{\omega}{2} \cdot 1} = 1 \Rightarrow \frac{\omega^2}{2} = 5 \Rightarrow \omega = \sqrt{10} = 3.16$  ✓

$\omega > 10$   $\frac{5}{\omega \cdot \frac{\omega}{2} \cdot \frac{\omega}{10}} = 1 \Rightarrow \frac{\omega^3}{20} = 5 \Rightarrow \omega^3 = 100 \Rightarrow \omega = 4.65$  不符合假设

① 假设  
 用②与③比较得结论

③