

例 设某控制系统的开环传递函数为

$$G(s)H(s) = \frac{10}{(s+1)(s+2)(s+3)}$$

 试用奈氏稳定判据判别闭环系统的稳定性。

$$1. \quad G(j\omega) = \frac{10}{(j\omega+1)(j\omega+2)(j\omega+3)} \quad G(j0+) = 1.67 \angle 0^\circ \quad G(j\infty) = 0 \angle -270^\circ$$

$$= -\frac{60(\omega^2-1)}{(\omega^2+1)(\omega^2+4)(\omega^2+9)} - j \frac{10\omega(11-\omega^2)}{(\omega^2+1)(\omega^2+4)(\omega^2+9)}$$

$$\omega_x = \sqrt{11}$$

$$\operatorname{Re}[G(j\omega_x)] = -0.17$$

$$P=0, \quad n=0$$

$$\therefore Z=0. \text{ 稳定}$$

例 某单位反馈系统，开环传递函数为， $G(s) = \frac{2}{s-1}$
 试用奈氏判据判别闭环系统稳定性。

$$2. \quad G(j\omega) = \frac{2}{j\omega-1} = -\frac{2}{\omega^2+1} - j \frac{2\omega}{\omega^2+1} = \frac{2}{\sqrt{\omega^2+1}} e^{j \arctan \omega}$$

$$G(j0+) = -2 \angle 0^\circ \quad G(j\infty) = 0 \angle -90^\circ$$

$$P=1$$

$$n=0.5$$

$$Z = P - 2n = 0$$

$$\therefore \text{稳定}$$

$\omega \rightarrow +\infty$
 $\arctan \omega \rightarrow +90^\circ$???

例 设某控制系统的开环传递函数为

$$G(s)H(s) = \frac{500}{(s+0.5)(s+1)(s+2)}$$

 试用奈氏稳定判据判别闭环系统稳定性。

$$3. \quad G(j\omega) = \frac{500}{(j\omega+0.5)(j\omega+1)(j\omega+2)} = -\frac{500[3.5\omega^2-1+j(3.5\omega-\omega^3)]}{(\omega^2+0.25)(\omega^2+1)(\omega^2+4)}$$

$$G(j0+) = 500 \angle 0^\circ \quad G(j\infty) = 0 \angle -270^\circ$$

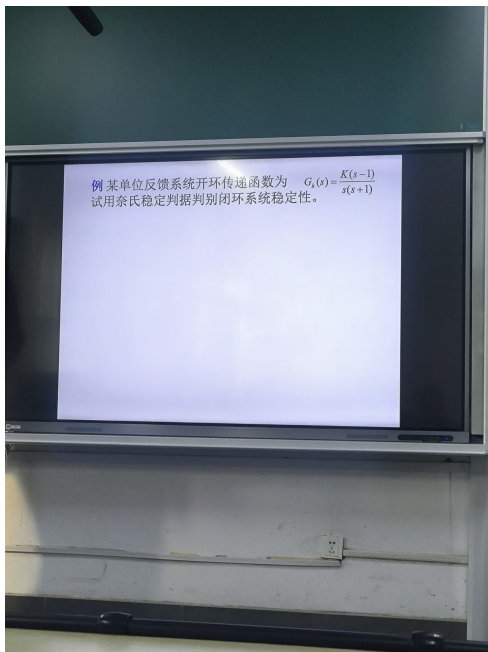
$$\omega_x = 1.87 \text{ rad/s} \quad \operatorname{Re}[G(j\omega_x)] = -44.44$$

$$P=0$$

$$n=-1$$

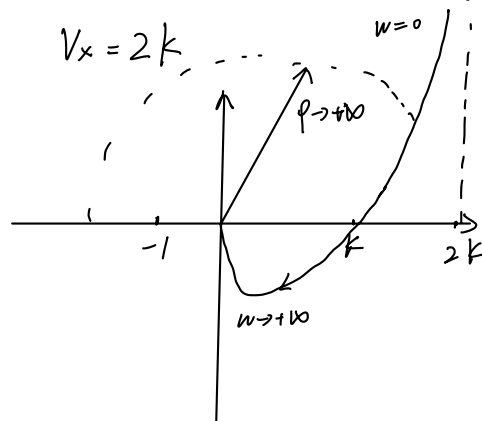
$$Z=2$$

$$\therefore \text{不稳定}$$



$$4. \quad G(j\omega) = \frac{k(j\omega-1)}{j\omega(j\omega+1)} = \frac{2\omega^2 + j\omega(1-\omega^2)}{\omega^2(\omega^2+1)} \cdot k$$

$$G(j0) = \infty \angle -90^\circ \quad G(j\infty) = 0 \angle -90^\circ$$



$$\omega x = 1$$

$$\operatorname{Re}[G(j\omega)] = k$$

$$P = 0$$

$$N = -0.5$$

$$Z = 1$$

\therefore 不稳定

