

$$20 \log \frac{k}{\omega} = 0 \rightarrow \omega = k \rightarrow -90 - \frac{180 \cdot kT}{\pi} \rightarrow \text{ib} : -90 - \frac{180 \cdot kT}{\pi}$$

$$\boxed{PM = 90 - \frac{180 \cdot kT}{\pi}} > 0 \rightarrow \frac{kT}{\pi} < \frac{1}{2} \rightarrow k < \frac{\pi}{2T} \quad (1)$$

$$\text{ib} : -90 - \frac{180 \cdot \omega T}{\pi} = -180 \rightarrow + \frac{180 \cdot \omega T}{\pi} = 90 \rightarrow \omega = \frac{\pi}{2T}$$

$$20 \log \frac{k}{\omega} \rightarrow 20 \log \frac{1+k}{\pi} \rightarrow \boxed{GM = -20 \log \frac{1+kT}{\pi}}$$

$$-20 \log \frac{1+kT}{\pi} > 0 \rightarrow 0 < \frac{1+kT}{\pi} < 1 \rightarrow k < \frac{\pi}{2T} \quad (2)$$

$$1, 2 \rightarrow 0 < k < \frac{\pi}{2T}$$

و ۱/۲ و ۱/۲



$$L(s) = \frac{k(s+1)}{s^2}$$

$$\text{Phase } s = -180 + \epsilon \delta = -180$$

-2

$$\tan^{-1}\left(\frac{w}{\epsilon}\right) - 180 = -180$$

$$\tan^{-1}\left(\frac{w}{\epsilon}\right) = 180 = -180 \rightarrow \tan^{-1}\left(\frac{w}{\epsilon}\right) = 0$$

$$\rightarrow |w = \epsilon|$$

$$20 \log \left( \frac{k(\sqrt{w^2 + \epsilon})}{1w\epsilon} \right)$$

$$= 20 \log \frac{\sqrt{1} k}{\epsilon} = 0 \rightarrow \boxed{k = \sqrt{2}}$$

$$G(s) = \frac{0.8(s+1)(1-s)}{s(0.5s+1)(1+s)}$$

-2

$$+90^\circ \text{ ; } 20 \text{ dB/dec} \leftarrow (1+s)$$

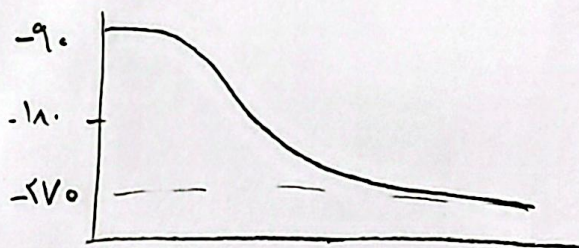
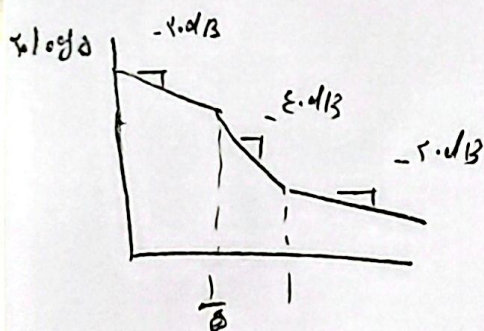
$$20 \log \delta \leftarrow 0$$

$$-90^\circ \text{ ; } -20 \text{ dB/dec} \leftarrow \frac{1}{s}$$

$$-90^\circ \text{ ; } +20 \text{ dB/dec} \leftarrow (1-s)$$

$$-90^\circ \text{ ; } -10 \text{ dB/dec} \leftarrow \frac{1}{1+s}$$

$$-90^\circ \text{ ; } -20 \text{ dB/dec} \leftarrow \frac{1}{(0.5s+1)}$$



$$20 \log \frac{0.8 \sqrt{w^2 + 1}}{w \sqrt{0.5w^2 + 1}} = 0 \rightarrow 20w^2 + 20 = 20w^2 + w^2 \rightarrow \dots \boxed{w_1 = 1.24, w_2 = 1.24}$$

$$\text{PM} = \tan^{-1}(w) = \frac{0.8w}{1} - 90 - \tan^{-1}(0.5w) = 0.107 - 18.48 - 90 - 10.91 =$$

$$\text{PM} = -24.5^\circ + 180 = \boxed{-155.5^\circ} < 0 \rightarrow \text{سیستم ناپایدار است}$$

$$\tan^{-1}(w) = \frac{0.8w}{1} - 90 - \tan^{-1}(0.5w) = -110$$

در این صورت، فرکانس ناپایدار

$$\rightarrow w > 0, \epsilon \rightarrow 20 \log \frac{0.8 \sqrt{(1.24)^2 + 1}}{1.24 \sqrt{0.5(1.24)^2 + 1}} = 18.11 \text{ dB}$$

$$\rightarrow \boxed{GM = 18.11 \text{ dB}} < 0 \rightarrow \text{سیستم ناپایدار}$$



Command Window

```
>>
>>
>>
>>
>>
>>
>>
>> a = 1;

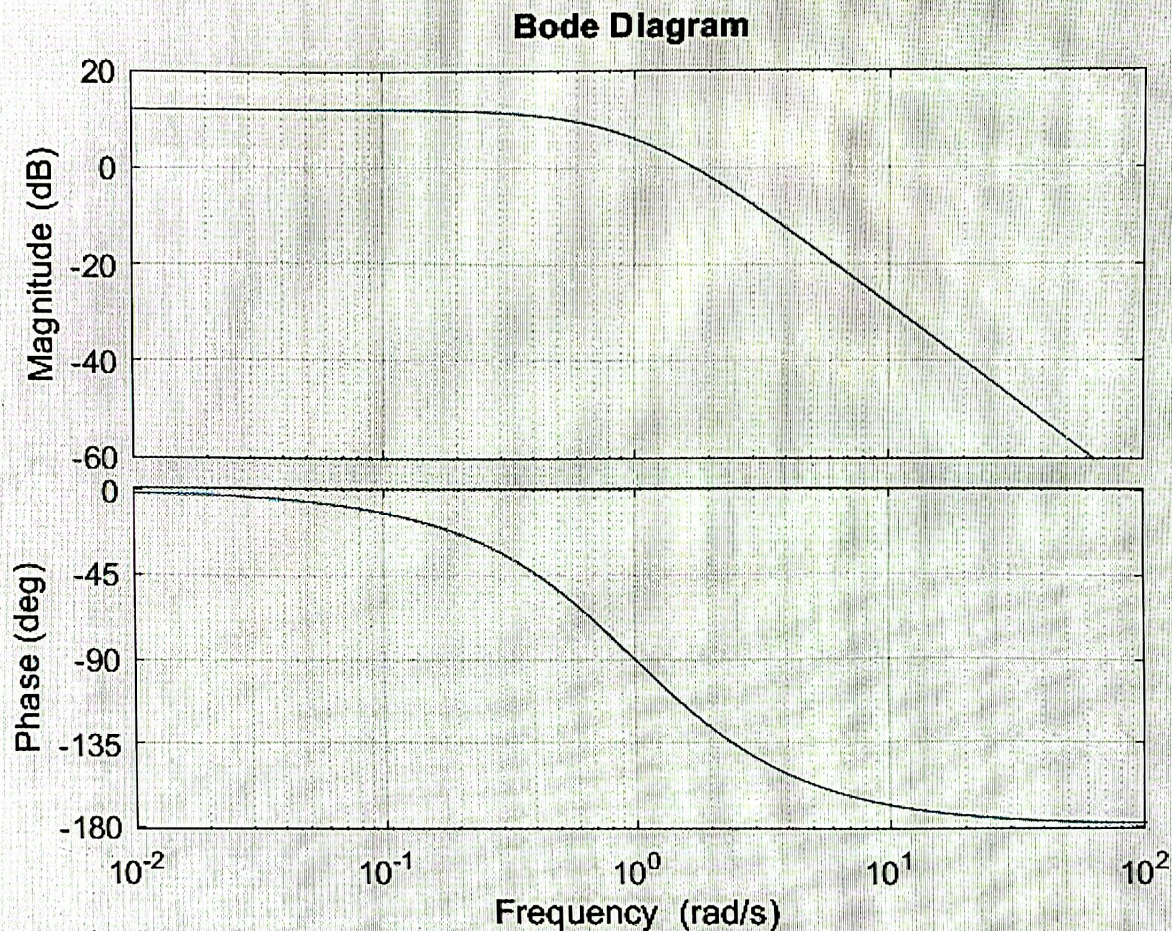
num = [4 * a^2];
den = [1, 2 * a, a^2];
```

```
sys = tf(num, den);
```

```
figure;
bode(sys);
grid on;
```

```
[Gm, Pm, Wcg, Wcp] = margin(sys);
disp(['حد بهره:', num2str(Gm), ' dB']);
disp(['حد فاز:', num2str(Pm), ' degrees']);
disp(['فرکانس قطع بهره:', num2str(Wcg), ' rad/s']);
disp(['فرکانس قطع فاز:', num2str(Wcp), ' rad/s']);
حد بهره: Inf dB
حد فاز: 60.0014 degrees
فرکانس قطع بهره: Inf rad/s
فرکانس قطع فاز: 1.732 rad/s
```

fx &gt;&gt;





$$\lim_{\omega \rightarrow 0} |G(s)| = 1 \rightarrow \frac{\xi a^2}{a^2 + \omega^2} = 1 \rightarrow \omega = \pm \sqrt{\xi} a \quad - \xi$$

باقی ہے نہ ایک ہی  $\alpha > 0$ ، فیکٹس کے لئے ہر چیز مثبت ہے۔

$$\rightarrow -\tan^{-1}\left(\frac{\omega}{a}\right) = -\tan^{-1}(\sqrt{\xi}) = \underline{-14.0^\circ}$$

$$PM = -14.0 + 11.0 = \underline{4.0^\circ}$$

$$-\tan^{-1}\left(\frac{\omega}{a}\right) = -11.0 \rightarrow \frac{\omega}{a} = \tan(9.0) \rightarrow \omega = +\infty$$

$$\lim_{\omega \rightarrow \infty} \frac{\xi a^2}{a^2 + \omega^2} = -\infty \rightarrow GM = -\infty \rightarrow \text{نہیں مستحکم، } \omega \rightarrow \infty$$