GM, PM for Stable System

Consider the **plant** given below.

$$G(s) = \frac{10}{\left(0.25s^2 + 0.40s + 1\right)}$$

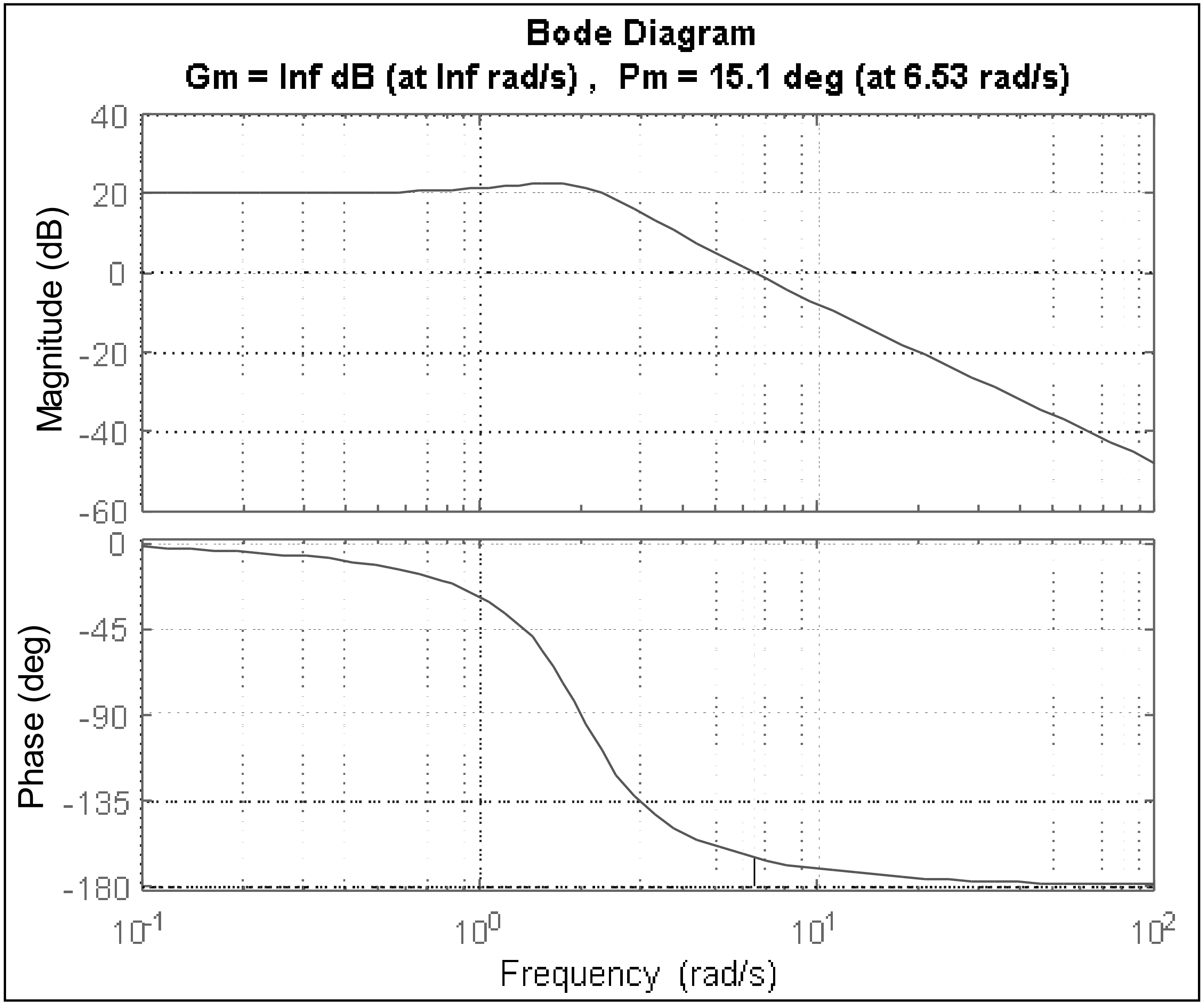
Obtain GCO, **PM** & PCO, **GM**.

$$100 = \left(1 - 0.25\omega^2\right)^2 + (0.4\omega)^2 \rightarrow 0.0625\omega^4 - 0.34\omega^2 - 99 = 0; \quad \omega^2 = 42.6$$

$$\omega_{GCO} = 6.53; \quad PM = 180 + \angle G(j6.53) = 180 - \tan^{-1}\frac{0.4\times 6.53}{1 - 0.25\times 6.53^2} = 15.1^o$$

$$\tan^{-1}\frac{0.4\omega}{1-0.25\omega^2} = 180 \rightarrow \frac{0.4\omega}{1-0.25\omega^2} = 0^- \rightarrow \omega_{PCO} = \infty; \quad GM = \frac{1}{\left|G(j\infty)\right|} = \frac{1}{0} = \infty$$

Verification with MATLAB



GM, PM for Unstable System

Consider the **plant** given below.

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

Obtain GCO, **PM** & PCO, **GM**.

$$4\left(1+\omega^2\right) = \omega^4\left(1+\omega^2\right)\left(4+\omega^2\right) \rightarrow \omega^6 + 4\omega^4 - 4 = 0; \quad \omega_{GCO} = 0.95$$

$$\angle G(j0.95) = -180 + 43.5 - 180 + 43.5 - 25.4 = -298.4; \quad PM = -118.4^o$$

$$-180 + \tan^{-1}\omega - 180 + \tan^{-1}(\omega) - \tan^{-1}(0.5\omega) = -180 \rightarrow \frac{2\omega}{1-\omega^2} = 0.5\omega$$

$$\omega^2 = -3; \quad \omega_{PCO} \text{ is undefined} \rightarrow \quad GM \text{ is undefined}$$

GM, PM for Unstable System