GATE: IN - 50.2023

EE23BTECH11224 - Sri Krishna Prabhas Yadla*

Question: The phase margin of the transfer function $G(s) = \frac{2(1-s)}{(1+s)^2}$ is _____ degrees. (rounded off to the nearest integer). (GATE IN 2023)

Solution:

Parameters	Description
ω_c	crossover frequency
$\angle G(j\omega)$	phase angle of the transfer function
PM	$\angle G(j\omega_c) + 180°$; Phase Margin

TABLE 1

PARAMETERS

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

$$|G(j\omega)| = \left| \frac{2(1 - j\omega)}{(1 + j\omega)^2} \right| \tag{2}$$

$$= \frac{2}{\sqrt{1 + \omega^2}} \tag{3}$$

$$\angle G(j\omega) = 3 \tan^{-1}(-\omega) \tag{4}$$

$$G(j\omega_c) = 1 \tag{5}$$

$$\implies \omega_c = \sqrt{3} \tag{6}$$

$$\implies \angle G(j\omega_c) = -180° \tag{7}$$
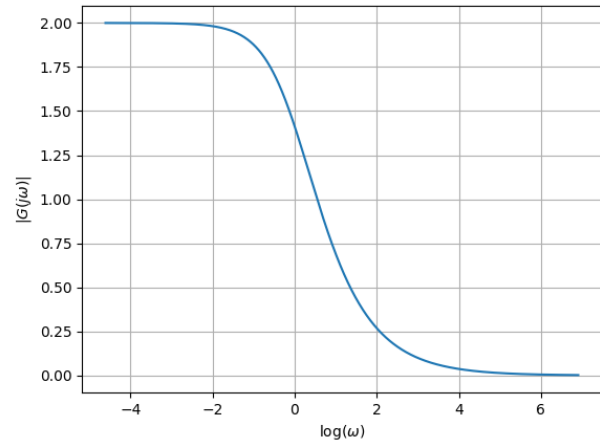
From Table 1,

$$PM = 0° \tag{8}$$
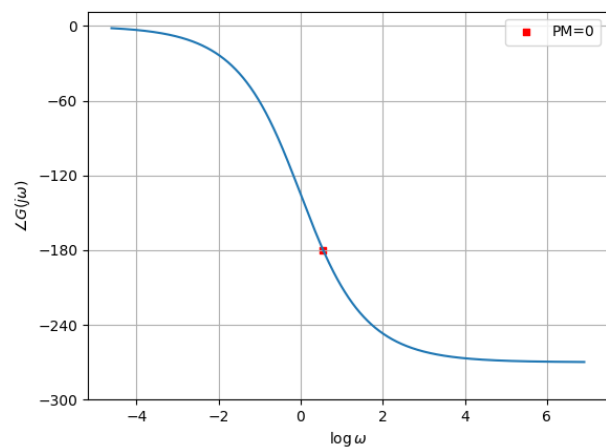

Fig. 1. Plot of $|G(j\omega)|$ vs $\log \omega$

Fig. 2. Plot of $\angle G(j\omega)$ vs $\log \omega$