

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	$\angle G(j\omega_c) + 180^\circ$; Phase Margin

TABLE I
PARAMETERS

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

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

$$= \frac{2}{\sqrt{1 + \omega^2}} \quad (3)$$

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

$$G(j\omega_c) = 1 \quad (5)$$

$$\Rightarrow \omega_c = \sqrt{3} \quad (6)$$

$$\Rightarrow \angle G(j\omega_c) = -180^\circ \quad (7)$$

From Table 1,

$$PM = 0^\circ \quad (8)$$

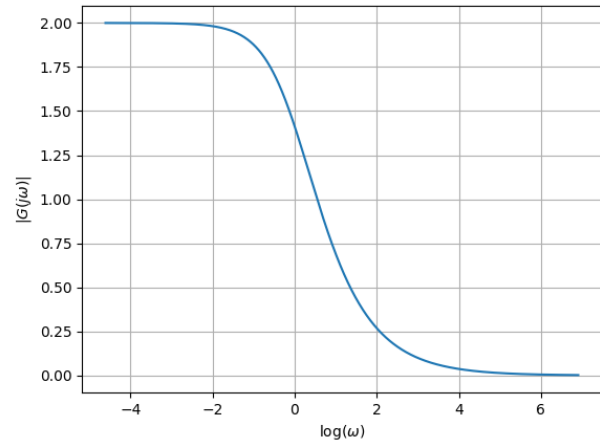


Fig. 1. Plot of $|G(j\omega)|$ vs $\log \omega$

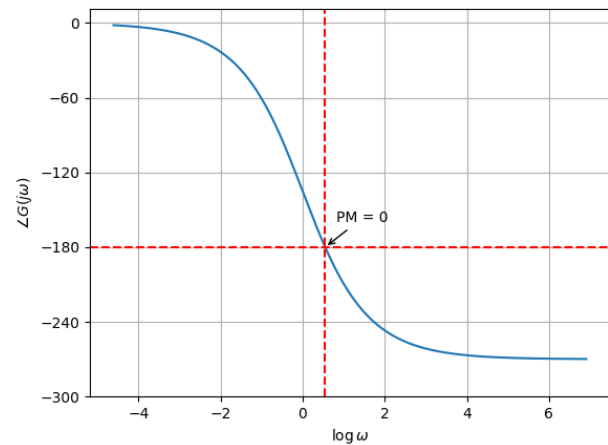


Fig. 2. Plot of $\angle G(j\omega)$ vs $\log \omega$