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
$\angle G(j\omega_c)$	phase angle of the transfer function
PM	Phase Margin

TABLE 1

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

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

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

$$\implies \omega_c = \sqrt{3} \tag{4}$$

$$G(j\omega) = \frac{2(1-j\omega)^3}{(1+\omega^2)^2} \tag{5}$$

$$\angle G(j\omega) = 3\tan^{-1}(-\omega) \tag{6}$$

$$\implies \angle G(j\omega_c) = -180^\circ \tag{7}$$

$$PM = \angle G(j\omega_c) + 180^\circ \tag{8}$$

$$= 0^\circ \tag{9}$$

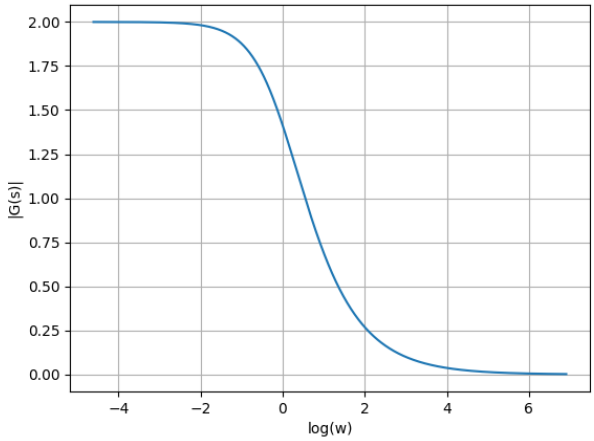

Fig. 1. Plot of $|G(j\omega)|$ vs $\log\omega$

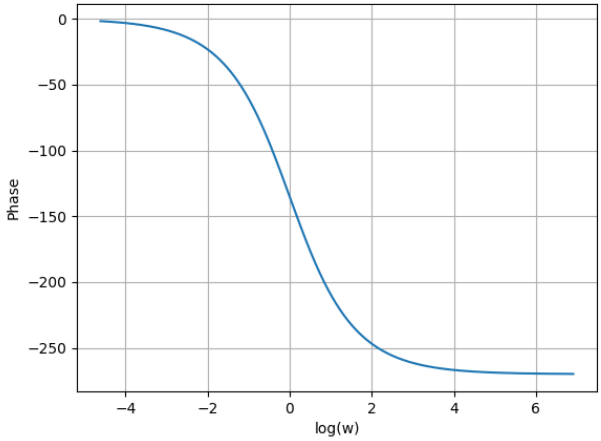

Fig. 2. Plot of $\angle G(j\omega)$ vs $\log\omega$