

# GATE 2021 CH Q52

EE23BTECH11009 - AROSHISH PRADHAN\*

**Question:** A system has a transfer function

$$G(s) = \frac{3e^{-4s}}{12s + 1}$$

When a step-change of magnitude  $M$  is given to the system input, the final value of the system output is measured to be 120. The value of  $M$  is \_\_\_\_\_.  
(GATE 2021 CH Q52)

**Solution:**

Symbol	Value	Description
$x(t)$	$Mu(t)$	Input Signal
$X(s)$	$\frac{M}{s}$	s-domain Input Signal
$y(t)$		Output Signal
$Y(s)$		s-domain Output Signal
$G(s)$	$\frac{3e^{-4s}}{12s+1}$	Transfer Function

TABLE I: Given Parameters

Given, input step-change:

$$x(t) = Mu(t) \quad (1)$$

$$u(t) \xleftrightarrow{\mathcal{L}} \frac{1}{s} \quad (2)$$

$$\Rightarrow X(s) = \frac{M}{s} \quad (3)$$

Transfer Function:

$$G(s) = \frac{Y(s)}{X(s)} = \frac{3e^{-4s}}{12s + 1} \quad (4)$$

$$\Rightarrow Y(s) = \frac{3e^{-4s}}{12s + 1} \frac{M}{s} \quad (5)$$

$\therefore$  system output

$$\lim_{s \rightarrow 0} sY(s) = 120 \quad (6)$$

$$\Rightarrow \lim_{s \rightarrow 0} \left( \frac{3e^{-4s}}{12s + 1} M \right) = 120 \quad (7)$$

$$\Rightarrow 3M = 120 \quad (8)$$

$$\Rightarrow M = 40 \quad (9)$$

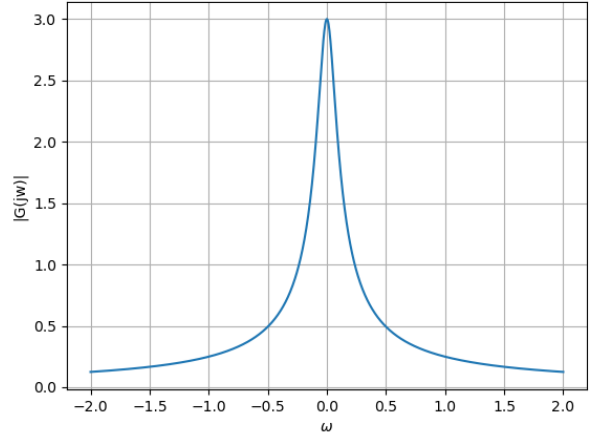


Fig. 1: Plot of  $|G(j\omega)|$   
vs  $\omega$