Gate21.IN.45

EE23BTECH11062 - V MANAS

Question:

A sinusoid ($\sqrt{2}sin(t)$)$\mu(t)$,where $\mu(t)$ is the step input,is applied to a system with transfer function G(s)=$\frac{1}{1+s}$.The amplitude of the steady state output is

Solution:

Parameter	Description	Value
x(t)	input signal	$\sqrt{2}sin(t) \cdot \mu(t)$
G(s)	Transfer function	$\frac{1}{1+s}$
ω_0	angular frequency of input signal	1
y(t)	output signal	

TABLE I
VARIABLES USED

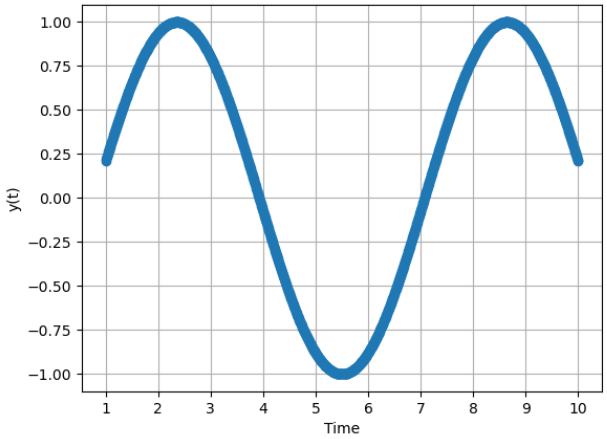

Fig. 1. plot of y(t)

$$G(s) = \frac{1}{s+1} \tag{1}$$

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

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

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

$$y(t) = \sqrt{2}|G(j\omega_0)|_{\omega=\omega_0} sin(t - \angle G(j\omega_0)_{\omega=\omega_0})u(t) \tag{5}$$

$$\implies y(t) = \sqrt{2}|G(j\omega)|_{\omega=1} sin(t - \angle G(j\omega)_{\omega=1})u(t) \tag{6}$$

$$|G(j\omega)|_{\omega=1} = \frac{1}{\sqrt{2}}, \angle G(j\omega)_{\omega=1} = -45° \tag{7}$$

$$y(t) = \sqrt{2} \times \frac{1}{\sqrt{2}} sin(t - 45°)u(t) \tag{8}$$

$$y(t) = sin(t - 45°)u(t) \tag{9}$$

So,the amplitude of steady state output is 1