CONTROL SYSTEMS

GATE 2018 problem:46

G Krupateja

EE18BTECH11015

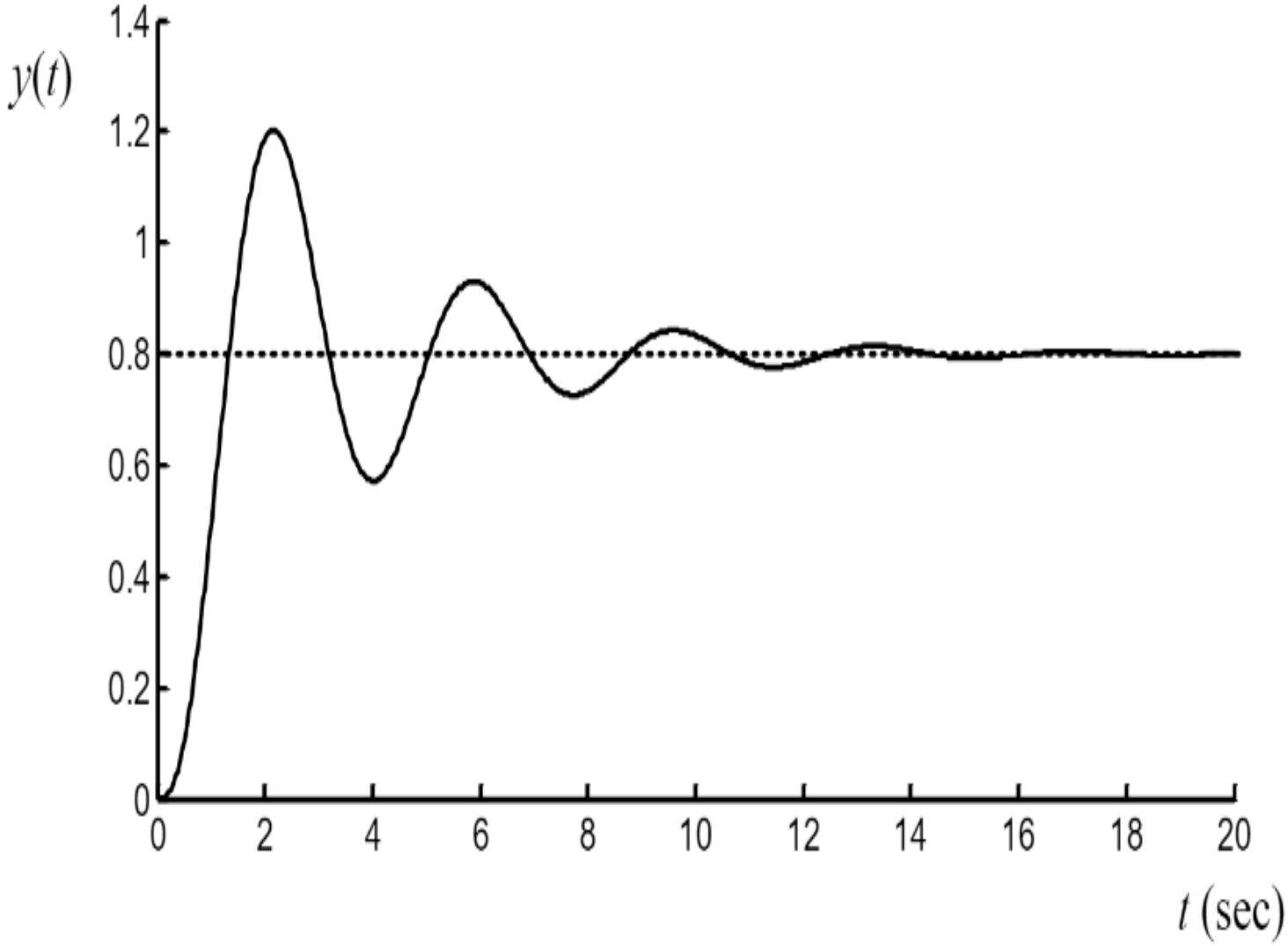
Question:46

The unit step response of y(t) of a unity feedback system with an open loop transfer function

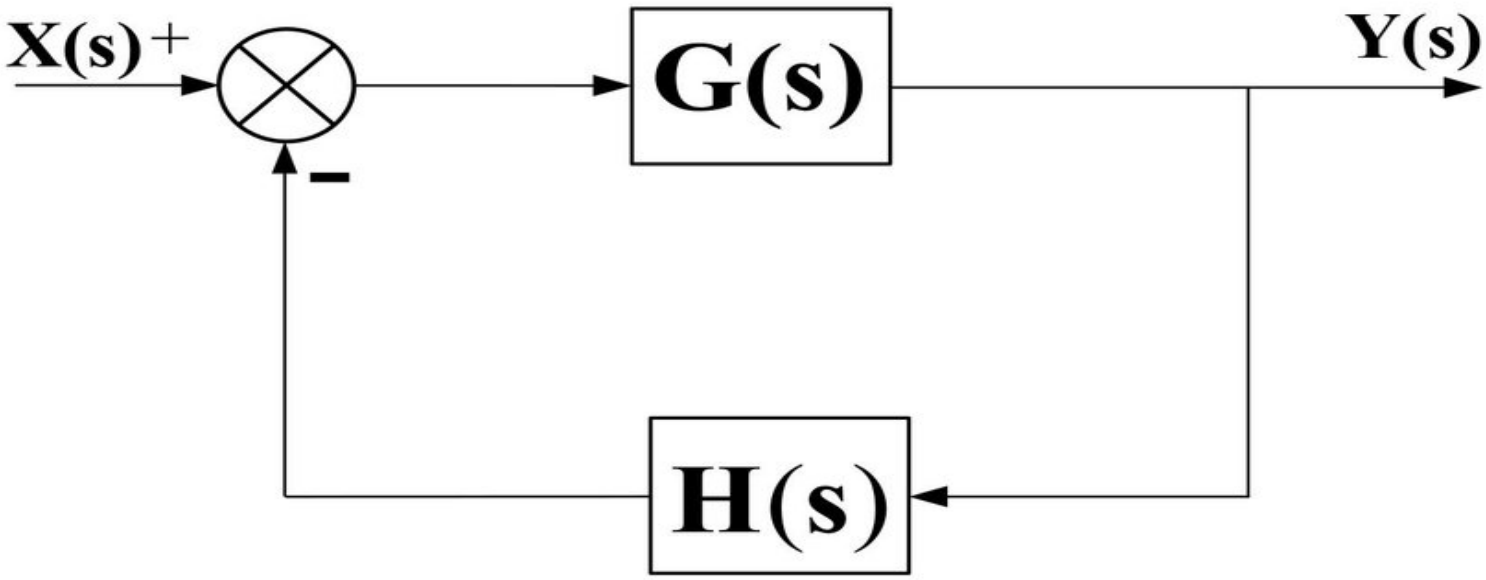
$$G(s)H(S) = \frac{K}{(s+1)^2(s+2)}$$

is shown in figure. The value of K is(up to two decimal places).

Figure



Figure



Unit feedback system.

Solution

Given,

$$G(s)H(s) = \frac{K}{(s+1)^2(s+2)}$$

We know that the input and output relation for open loop transfer function for a unity feedback system is given by,

$$\frac{Y(s)}{X(s)} = \frac{G(s)}{1 + G(s)H(s)} = \frac{G(s)}{1 + G(s)}$$

Now, substituting the G(s)H(s) in the above equation we will get the below,

$$\frac{Y(s)}{X(s)} = \frac{\frac{K}{(s+1)^2(s+2)}}{1 + \frac{K}{(s+1)^2(s+2)}}$$

Solution continued

$$\frac{Y(s)}{X(s)} = \frac{K}{K + (s+1)^2(s+2)}$$

According to the question,

$$X(s) = \frac{1}{s}$$

So,

$$Y(s) = \frac{1}{s} \frac{K}{K + (s+1)^2(s+2)}$$

From final value theorem,

$$y(\infty) = \lim_{s \to 0} sY(s) = 0.8$$

[From the response shown in the figure steady state value in the time domain is 0.8]

Solution continued

$$\frac{K}{K+2} = 0.8$$

$$K = 1.6 + 0.8K$$

$$K = 8$$

Hence,the value of K is 8