CONTROL SYSTEMS

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GATE 2016 Q19(EC SECTION)

QUESTION

The response of the system

$$G(s) = \frac{s-2}{(s+1)(s+3)}, \tag{1}$$

to the unit step input u(t) is y(t). The value of $\frac{dy}{dt}$ at t=$0^{+}is$:

SOLUTION

Input of the system,

$$x(t) = u(t) \tag{2}$$

Where u(t) is a unit step input. The Laplace transform x(t) is:

$$X(s) = \int_{-\infty}^{\infty} x(t)e^{-st}dt \tag{3}$$

Therefore,

$$X(s) = \frac{1}{s} \tag{4}$$

Solution

We know that,

$$Y(s) = X(s)H(s) \tag{5}$$

in Laplace domain.So,

$$Y(s) = \frac{s-2}{s(s+1)(s+3)} \tag{6}$$

By doing partial fractions,

$$\frac{s-2}{s(s+1)(s+3)} = \frac{A}{s} + \frac{B}{s+1} + \frac{C}{s+3} \tag{7}$$

SOLUTION

On solving,

$$A = \frac{-2}{3}, B = \frac{3}{2}, C = \frac{-5}{6} \tag{8}$$

From this,

$$Y(s) = \frac{-2}{3s} + \frac{3}{2(s+1)} + \frac{-5}{6(s+3} \tag{9}$$

The inverse Laplace transform of Y(s) is:

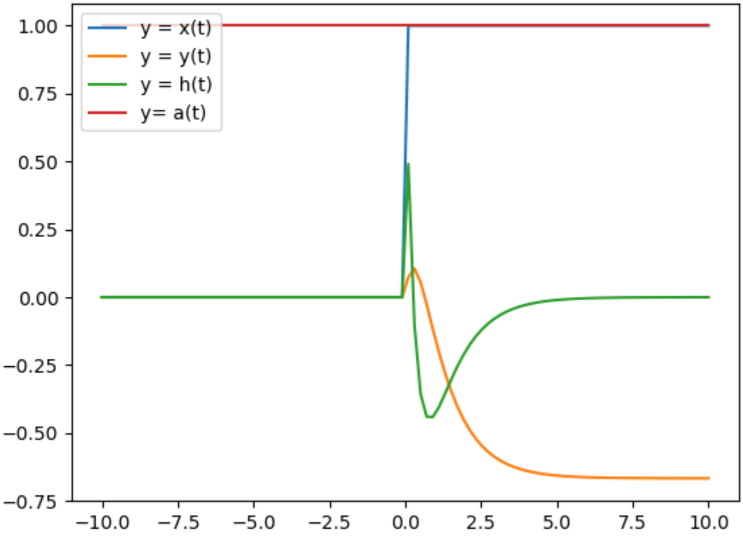
$$y(t) = (\frac{-2}{3} + \frac{3}{2}e^{-t} + \frac{-5}{6}e^{-3t})u(t) \tag{10}$$

On differentiating we get,

$$\frac{dy(t)}{dt} = \frac{-3}{2}e^{-t} + \frac{5}{2}e^{-3t} \tag{11}$$

Therefore,

$$\frac{dy(0^+)}{dt} = \frac{-3}{2} + \frac{5}{2} = 1 \tag{12}$$


y = x(t)
y = y(t)
y = h(t)
y= a(t)
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−10.0
−7.5
−5.0
−2.5
0.0
2.5
5.0
7.5
10.0