# Control Systems

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# Frequency Response

For a system having transfer function

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

a unit step is applied at time t = 0. The value of the response of the system at t= 1.5sec is:

.

# Solution

We know that,

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

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

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

From this,

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

## Solution

We know that,

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

in Laplace domain.So,

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

By doing partial fractions,

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

By this,

$$A = 1, B = -2 \tag{8}$$

From this,

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

Thw inverse Laplace transform of Y(s) is:

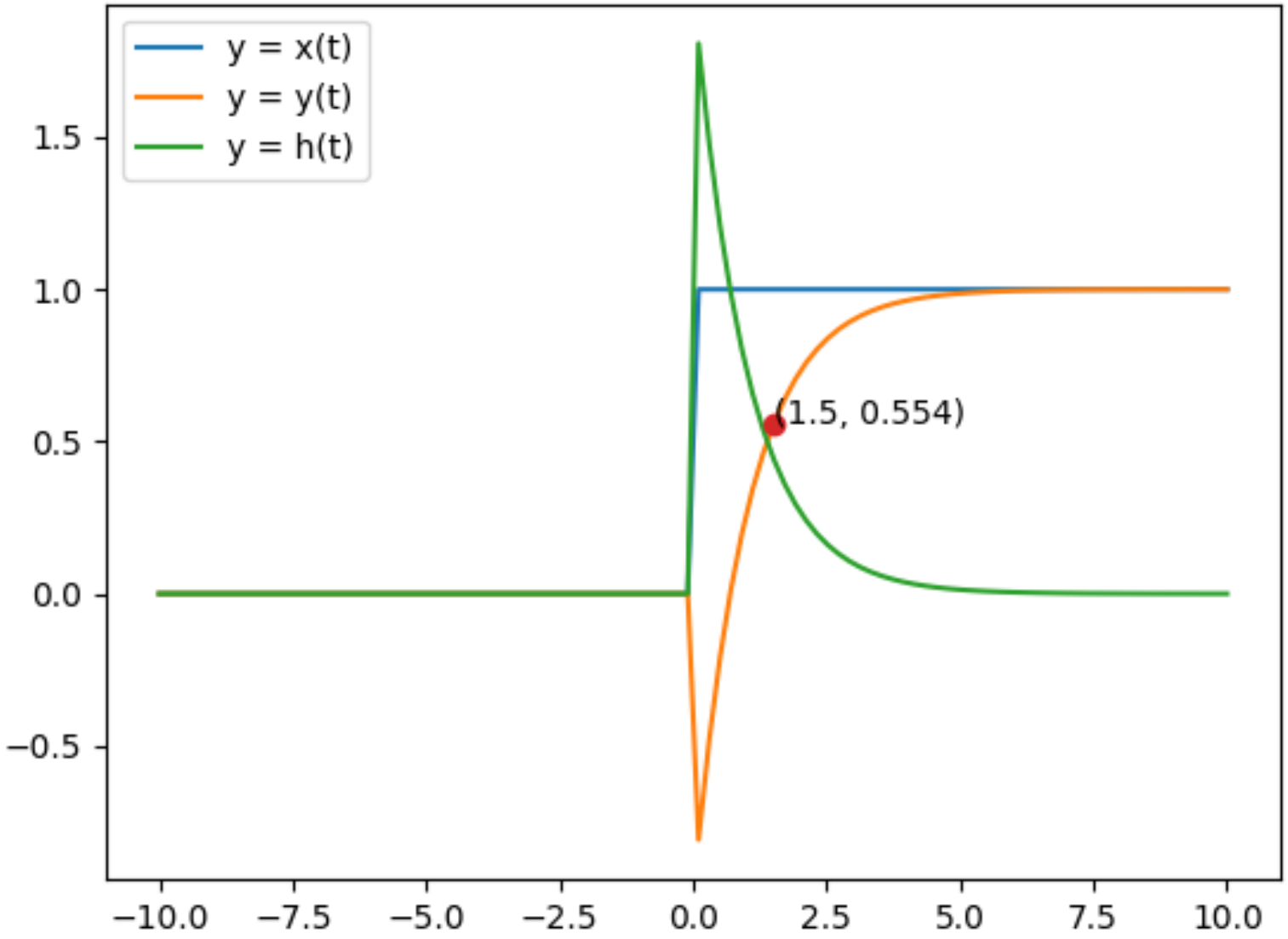
$$y(t) = u(t) - 2e^{t}u(t) \tag{10}$$

u(t) = 1 for all t >0 .So,at t = 1.5sec,

$$y(1.5) = 1 - 2e^{1} \tag{11}$$

$$y(1.5) = 0.5537 \tag{12}$$

The value of the response of the system at t = 1.5sec is 0.5537


y = x(t)
y = y(t)
y = h(t)
(1.5, 0.554)
1.5
1.0
0.5
0.0
−0.5
−10.0
−7.5
−5.0
−2.5
0.0
2.5
5.0
7.5
10.0