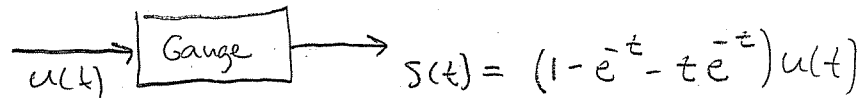


A pressure gauge that can be modeled as an LTI system has a time response to a unit step input given by  $(1 - e^{-t} - te^{-t})u(t)$ .

For a certain input  $x(t)$ , the output is observed to be  $(2 - 3e^{-t} + e^{-3t})u(t)$ .

For this observed measurement, determine the true pressure input to the gauge as a function of time.

Experiment # 1 was conducted

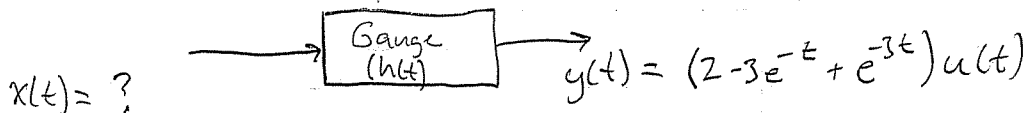


We know that the step response  $s(t)$  is the integral of the impulse response  $h(t)$ , so... product rule of derivatives

$$h(t) = \frac{d}{dt} s(t) = (0 + e^{-t} + te^{-t} - e^{-t})u(t) + \underbrace{(1 - e^{-t} - te^{-t})}_{\text{zero when } t=0} \delta(t)$$

$$= te^{-t}u(t)$$

Experiment # 2 was conducted



The Laplace transform of this experiment is

$$x(t) * h(t) = y(t) \iff X(s)H(s) = Y(s)$$

and we know that  $H(s) = \frac{1}{(s+1)^2}$  and  $Y(s) = \frac{2}{s} - \frac{3}{s+1} + \frac{1}{s+3}$

according to p.591 of the textbook, so

$$X(s) = Y(s)/H(s) = (s+1)^2 \left[ \frac{2}{s} - \frac{3}{s+1} + \frac{1}{s+3} \right] = \text{algebra} \dots = \frac{6(s+1)}{s(s+3)}$$

$$= \frac{A}{s} + \frac{B}{s+3} \quad A = \frac{6(0+1)}{(0+3)} = 2$$

$$B = \frac{6(-3+1)}{-3} = 4$$

and  $x(t) = (2 + 4e^{-3t})u(t)$