1

a)

$$\frac{Y(s)}{U(s)} = \frac{1}{s^2 + 6s + 5}$$

$A + B$

$\cancel{A}s = 1$

$A + 5B = 6$

$A = 6 - 5B$

$6 - 4B = 1$

$B = \frac{5}{4}$

$A = -\frac{1}{4}$

1) a)

1 b)

$$\mathcal{L}(1\ddot{y} + 6\dot{y} + 5y) = u \qquad y(0) = 1 \quad \dot{y}(0) = 0$$

$$1(s^2 Y(s) - s y(0) - \dot{y}(0)) + 6(s Y(s) - y(0)) + 5 Y(s) = 0$$

$$(s^2 + 6s + 5) Y(s) - s - 0 - 6 = 0$$

$$Y(s) = \frac{s+6}{s^2+6s+5} = \frac{s+6}{(s+5)(s+1)} \qquad A(s+1) + B(s+5)$$

$$\mathcal{L}^{-1}(Y(s)) = \cancel{\mathcal{L}^{-1}\left(\frac{s+3}{(s^2+3)^2-4}\right)} + \cancel{\mathcal{L}^{-1}\left(\frac{3}{(s+3)^2-4}\right)}$$

$$= -\frac{1}{4}\frac{1}{s+5} + \frac{5}{4}\frac{1}{s+1}$$

$$\boxed{y(t) = -\frac{1}{4}e^{-5t} + \frac{5}{4}e^{-t}}$$

2

$$U = m_1 \ddot{x}_1 + b_1 \dot{x}_1 + K_3(x_1 - x_2) + k_1 x_1$$

$$0 = m_2 \ddot{x}_2 + b_2 x_2 + K_3(x_2 - x_1) + K_2 x_2$$

$\mathcal{L}$ form

$$U(s) = m_1 x_1(s) s^2 + b_1 x_1(s) s + K_3 (x_1(s) - x_2(s)) + K_1 x_1(s)$$

$$0 = m_2 x_2(s) s^2 + b_2 x_2(s) s + K_3 (x_2(s) - x_1(s)) + K_2 x_2(s)$$

$$U(s) = (m_1 s^2 + b_1 s + K_3 + K_1) x_1(s) - K_3 x_2(s)$$

$$(m_2 s^2 + b_2 s + K_3 + K_2) x_2(s) - K_3 (x_1(s))$$

$$\frac{(m_2 s^2 + b_2 s + K_3 + K_2) x_2(s)}{K_3} = x_1(s)$$

$$\frac{(m_1 s^2 + b_1 s + K_3 + K_1)(m_2 s^2 + b_2 s + K_3 + K_2) - K_3}{K_3} = \frac{U(s)}{x_2(s)}$$

$$\boxed{\frac{X_2(s)}{U(s)} = \frac{K_3}{(m_1 s^2 + b_1 s + K_3 + K_1)(m_2 s^2 + b_2 s + K_3 + K_2)} - 1}$$

$$m_1 s^2 + b_1 s + K_3 + K_1 - (m_2 s^2 + b_2 s + K_3 + K_2) = \frac{U(s)}{X_1(s)}$$

$$\boxed{\frac{1}{(m_1 s^2 + b_1 s + K_3 + K_1) - (m_2 s^2 + b_2 s + K_3 + K_2)} = \frac{X_1(s)}{U(s)}}$$

$$\frac{e_o}{e_i} = \frac{Z_2}{Z_1 + Z_2}$$

$$Z_1 = R_1 + \frac{1}{C_1 s}$$

$$Z_2 = R_2 + \frac{1}{C_2 s}$$

$$\frac{e_o}{e_i} = \frac{R_2 + \frac{1}{C_2 s}}{\left(R_1 + \frac{1}{C_1 s}\right)\left(R_2 + \frac{1}{C_2 s}\right)}$$

4)

$$G(s) = \frac{2s+4}{s^2+6s+10} = \frac{2s+4}{(s+3)^2+1} = 2\,\frac{s+\cancel{1}2}{(s+3)^2+1}$$

$$= 2\left(\frac{s+\cancel{4}3}{(s+3)^2+1} + \frac{1}{(s+3)^2+1}\right)$$

$$\mathcal{L}^{-1}(G(s)) = \boxed{e^{-3t}\cos(t)\ \ e^{-3t}\sin(t)}$$

$$\mathcal{L}^{-1}(G(s)) = 2\left(e^{-3t}\cos(t) - e^{-3t}\sin(t)\right)$$

5)

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

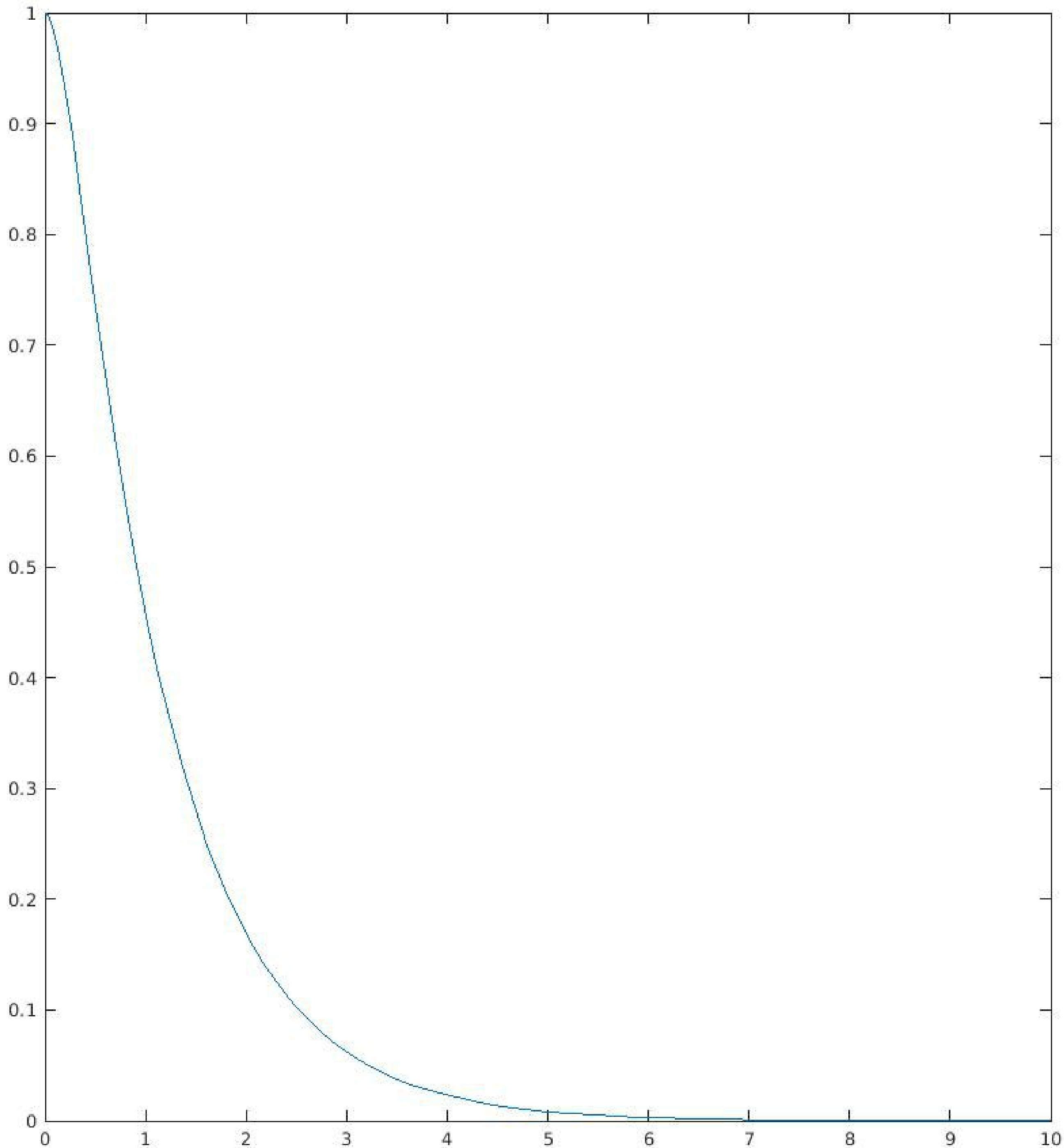
$$= \frac{(s+1)^2}{(s+1)^3} - \frac{(s-1)}{(s+1)^3}$$

$$= \frac{1}{s+1} - \frac{s-1}{(s+1)^3}$$

$$= \frac{1}{s+1} - \frac{s+1}{(s+1)^3} + \frac{2}{(s+1)^3}$$

$$= \frac{1}{s+1} - \frac{1}{(s+1)^2} + \frac{2}{(s+1)^3}$$

$$\mathcal{L}^{-1}(G(s)) = e^{-t} - t + t^2$$



1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
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0
1
2
3
4
5
6
7
8
9
10