1

a)

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

$A + B$

$2s = 1$

$A + 5B = 6$

$A = 6 - 5B$

$6 - 4B = 1$

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

$A = -1/4$

1) a)

[illegible]

1 b)

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

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

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

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

$\mathcal{L}^{-1}(Y(s)) =$ [illegible]

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

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

2

$$U = m_1 \ddot{x}_1 + b_1 \dot{x}_1 + k_3(x_1 - x_2) + k_1 x_1$$

$$0 = m_2 \ddot{x}_2 + b_2 x_2 + k_3(x_2 - x_1) + k_2 x_2$$

L form

$$U(s) = m_1 x_1(s) s^2 + b_1 x_1(s) s + k_3(x_1(s) - x_2(s)) + k_1 x_1(s)$$

$$0 = m_2 x_2(s) s^2 + b_2 x_2(s) s + k_3(x_2(s) - x_1(s)) + k_2 x_2(s)$$

$$\frac{U(s)}{} = (m_1 s^2 + b_1 s + k_3 + k_1) x_1(s) - k_3 x_2(s)$$

$$(m_2 s^2 + b_2 s + k_3 + k_2) x_2(s) - k_3(x_1(s))$$

$$\frac{(m_2 s^2 + b_2 s + k_3 + k_2) x_2(s) = x_1(s)}{k_3}$$

$$\frac{(m_1 s^2 + b_1 s + k_3 + k_1)(m_2 s^2 + b_2 s + k_3 + k_2) - k_3}{k_3} = \frac{U(s)}{x_2(s)}$$

$$\boxed{\frac{X_2(s)}{U(s)} = \frac{k_3}{(m_1 s^2 + b_1 s + k_3 + k_1)(m_2 s^2 + b_2 s + k_3 + k_2) - 1}}$$

$$m_1 s^2 + b_1 s + k_3 + k_1 - (m_2 s^2 + b_2 s + k_3 + k_2) = \frac{U(s)}{x_1(s)}$$

$$\boxed{\frac{1}{(m_1 s^2 + b_1 s + k_3 + k_1) - (m_2 s^2 + b_2 s + k_3 + k_2)} = \frac{x_1(s)}{U(s)}}$$

$$\frac{V_2}{V_1} = \frac{Z_2}{Z_1 + Z_2}$$

$$Z_1 = R_1 + \frac{1}{Cs}$$

$$Z_2 = R_2 + \frac{1}{Cs}$$

$$\frac{V_2}{V_1} = \frac{R_2 + \frac{1}{Cs}}{\left(R_1 + \frac{1}{Cs}\right)\left(R_2 + \frac{1}{Cs}\right)}$$

4)

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

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

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

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

5)

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

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

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

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

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

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