1

$$F(s) = \frac{3s+5}{s^3+4s^2+5s+2}$$

$$S_0 = -1$$

$$\begin{array}{r|rrrr} -1 & 1 & 4 & 5 & 2 \\ \hline & 1 & 3 & 2 & 0 \end{array}$$

$$s^2+3s+2$$

$$\Delta = 9-8 = 1$$

$$s = \frac{-3 \pm 1}{2} \quad S_1 = -1, \quad S_2 = -2$$

$$F(s) = \frac{3s+5}{(s+1)^2(s+2)}$$

$$\frac{As+B}{(s+1)^2} + \frac{C}{(s+2)}$$

$$As^2 + 2As + Bs + 2B + Cs^2 + 2Cs + C$$

$$\begin{cases} A+C = 0 \rightarrow A = -C \\ 2A+B+2C = 3 \rightarrow B = 3 \\ 2B+C = 5 \end{cases}$$

$$C = -1$$

$$A = 1$$

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

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

$$L^{-1}\left\{\frac{1}{s+1}\right\} - L^{-1}\left\{\frac{1}{(s+1)^2}\right\} + 3L^{-1}\left\{\frac{1}{(s+1)^2}\right\}$$

$$+ L^{-1}\left\{\frac{1}{s+2}\right\} = \underline{e^{-t} + 2te^{-t} + e^{-2t}}$$

(2) $m\ddot{x} + b\dot{x} + Kx = u$

$$mL\{\ddot{x}\} + bL\{\dot{x}\} + KL\{x\} = 18L\{1\}$$

$$m\left(s^2L\{x\} - sx(0) - x'(0)\right) + b\left(sL\{x\}\right.$$

$$\left. - x(0)\right) + KL\{x\} = \frac{18}{s}$$

$$ms^2\mathcal{L}\{x\} - msx_0 - m\dot{x}_0 + bs\mathcal{L}\{x\}$$

$$- bx_0 + k\mathcal{L}\{x\} = \frac{18}{s}$$

$$\mathcal{L}\{x\}(ms^2+bs+k) = \frac{18}{s} + x_0(ms+b) + m\dot{x}_0$$

$$\mathcal{L}\{x\}(s^2+6s+18) = \frac{18}{s} + (s+6) + 3$$

$$\mathcal{L}\{x\} = \frac{\frac{18}{s} + s + 9}{s^2+6s+18}$$

$$\mathcal{L}\{x\} = \frac{\frac{18}{s} + (s+3) + 6}{(s+3)^2 + 9} = \frac{(s+3)}{(s+3)^2+3^2} + 2\cdot\frac{3}{(s+3)^2+3^2}$$

$$+ \frac{1}{s}\cdot 6\cdot\frac{3}{(s+3)^2+3^2}$$

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

$$+ 6\int_0^t 1 \cdot e^{-3t} \operatorname{sen}(3t)\,dt = 1 - e^{-3t}(\cos 3t + \operatorname{sen} 3t)$$

$$x = e^{-3t}\cos(3t) + 2e^{-3t}\operatorname{sen}(3t) + 1 - e^{-3t}(\cos(3t) + \operatorname{sen}(3t)) = 1 + e^{-3t}\operatorname{sen}(3t)$$

③

$$\begin{cases} \tau_m = K_t \cdot i \\ V_b = K_t \cdot \dot{\theta} \end{cases}$$

$$J\ddot{\theta} + b\dot{\theta} = K_t i$$

$$L\dot{i} + Ri + K_t\dot{\theta} = V$$

$$\tau_m - b\dot{\theta} = J\ddot{\theta}$$

$$Ri + L\dot{i} + V_b = V$$

$$Js^2\Theta(s) + bs\Theta(s) = K_t I(s)$$

$$I(s) = \frac{Js^2 + bs}{K_t}\Theta(s)$$

$$Ls\,I(s) + R\,I(s) + K_t s\,\Theta(s) = V(s)$$

$$\left(\frac{(Ls+R)(Js^2+bs)}{K_t} + K_t s\right)\Theta(s) = V(s)$$

$$\frac{\Theta(s)}{V(s)} = \frac{K_t}{K_t^2 s + (Ls+R)(Js^2+bs)}$$

$$JLs^3 + (Lb+RJ)s^2 + (Rb+K_t^2)s + 0$$

(4) $$m\ddot{x} + (b+K_v)\dot{x} + K_pK_v x = K_pK_v \underset{\downarrow 1}{x_r}$$

$$ms^2\mathcal{L}\{x\} + (b+K_v)s\,\mathcal{L}\{x\} + K_pK_v\mathcal{L}\{x\} = \frac{K_pK_v}{s^2}$$

$$\mathcal{L}\{x\} = \frac{K_pK_v}{s^2(ms^2+(b+K_v)s+K_pK_v)}$$

$x = L^{-1}q \quad \ldots \quad \varphi$