

4. (2 pts) $H(s) = \frac{12(2)(4)s}{(s^2 + 16)^2} - \frac{s \cos(5) - (-9)\sin(5)}{(s^2 + 16)^2} = \boxed{\frac{96s}{(s^2 + 16)^2} - \frac{s \cos(5) + 9 \sin(5)}{(s^2 + 16)^2}}$

5. (2 pts)

$$G(s) = \frac{1-4s}{3s^2-2s+3} = \frac{1-4s}{3\left(s^2 - \frac{2}{3}s + 1\right)} = \frac{1-4\left(s - \frac{1}{3} + \frac{1}{3}\right)}{3\left(\left(s - \frac{1}{3}\right)^2 + \frac{8}{9}\right)} = \frac{1}{3} \left[-\frac{\frac{1}{3}\frac{\sqrt{8}}{\sqrt{8}}}{\left(s - \frac{1}{3}\right)^2 + \frac{8}{9}} - \frac{4\left(s - \frac{1}{3}\right)}{\left(s - \frac{1}{3}\right)^2 + \frac{8}{9}} \right]$$

$$\boxed{g(t) = -\frac{1}{3} \left[\frac{1}{3\sqrt{8}} e^{\frac{1}{3}t} \sin\left(\frac{\sqrt{8}}{3}t\right) + 4e^{\frac{1}{3}t} \cos\left(\frac{\sqrt{8}}{3}t\right) \right]}$$

7. (3 pts)

$$G(s) = \frac{A}{s} + \frac{B}{s^2} + \frac{C}{s+3} \quad \rightarrow \quad 6s + 7 = As(s+3) + B(s+3) + Cs^2$$

$$s=0 : \quad 7 = B(3) \quad \Rightarrow \quad A = \frac{11}{9}$$

$$s=-3 : \quad -11 = C(9) \quad \Rightarrow \quad B = \frac{7}{3}$$

$$s=1 : \quad 13 = A(4) + B(4) + C \quad \Rightarrow \quad C = -\frac{11}{9}$$

$$G(s) = \frac{\frac{11}{9}}{s} + \frac{\frac{7}{3}}{s^2} - \frac{\frac{11}{9}}{s+3} \quad \rightarrow \quad \boxed{g(t) = \frac{11}{9} + \frac{7}{3}t - \frac{11}{9}e^{-3t}}$$

8. (3 pts)

$$H(s) = \frac{As+B}{s^2+1} + \frac{Cs+D}{s^2+8s+3} \quad 9s+4 = (As+B)(s^2+8s+3) + (Cs+D)(s^2+1)$$

$$= (A+C)s^3 + (8A+B+D)s^2 + (3A+8B+C)s + 3B+D$$

$$s^3 : \quad A+C=0 \quad \Rightarrow \quad A = -\frac{7}{34}$$

$$s^2 : \quad 8A+B+D=0 \quad \Rightarrow \quad B = \frac{40}{34}$$

$$s^1 : \quad 3A+8B+C=9 \quad \Rightarrow \quad C = \frac{7}{34}$$

$$s^0 : \quad 3B+D=4 \quad \Rightarrow \quad D = \frac{16}{34}$$

$$H(s) = \frac{1}{34} \left[\frac{-7s+40}{s^2+1} + \frac{7s+16}{(s+4)^2-13} \right] = \frac{1}{34} \left[\frac{-7s+40}{s^2+1} + \frac{7(s+4)-4}{(s+4)^2-13} \right]$$

$$= \frac{1}{34} \left[\frac{-7s}{s^2+1} + \frac{40}{s^2+1} + \frac{7(s+4)}{(s+4)^2-13} - \frac{12\frac{\sqrt{13}}{\sqrt{13}}}{(s+4)^2-13} \right]$$

$$\boxed{h(t) = \left[\frac{1}{34} \left[-7 \cos(t) + 40 \sin(t) + 7e^{-4t} \cosh(\sqrt{13}t) - \frac{12}{\sqrt{13}} e^{-4t} \sinh(\sqrt{13}t) \right] \right]}$$

$$1. F(s) = \frac{7!}{s^{7+1}} + \frac{7\sqrt{\pi}}{2s^{\frac{3}{2}}} - \frac{8(1)(3)(5)(7)\sqrt{\pi}}{2^4 s^{4+\frac{1}{2}}} - \frac{8}{s} = \boxed{\frac{5040}{s^{7+1}} + \frac{7\sqrt{\pi}}{2s^{\frac{3}{2}}} - \frac{105\sqrt{\pi}}{2s^{\frac{9}{2}}} - \frac{8}{s}}$$

$$2. H(s) = \frac{24}{s^2 + 64} + \frac{6s}{(s+5)^2 + \frac{9}{16}}$$

$$3. G(s) = \frac{10}{s-4} - \frac{7s}{s^2+1} + \frac{s}{s^2-4}$$

6.

$$F(s) = \frac{A}{s+2} + \frac{B}{s-1} + \frac{C}{4s-3} \rightarrow 2s^2 - 1 = A(s-1)(4s-3) + B(s+2)(4s-3) + C(s+2)(s-1)$$

$$\begin{aligned} s = -2 : \quad 7 &= A(-3)(-11) & A &= \frac{7}{33} \\ s = 1 : \quad 1 &= B(3)(1) & \Rightarrow & B = \frac{1}{3} \\ s = \frac{3}{4} : \quad \frac{1}{8} &= C\left(\frac{11}{4}\right)\left(-\frac{1}{4}\right) & C &= -\frac{2}{11} \end{aligned}$$

$$F(s) = \frac{\frac{7}{33}}{s+2} + \frac{\frac{1}{3}}{s-1} - \frac{1}{4} \frac{\frac{2}{11}}{s-\frac{3}{4}} \rightarrow \boxed{f(t) = \frac{7}{33} e^{-2t} + \frac{1}{3} e^t - \frac{1}{22} e^{\frac{3}{4}t}}$$

$$9. F(s) = \frac{A}{s-2} + \frac{Bs+C}{s^2+2} + \frac{Ds+E}{(s^2+2)^2}$$

$$\begin{aligned} s+s^2 &= A(s^2+2)^2 + (Bs+C)(s-2)(s^2+2) + (Ds+E)(s-2) \\ &= (A+B)s^4 + (-2B+C)s^3 + (4A+2B-2C+D)s^2 + (-4B+2C-2D+E)s \\ &\quad + 4A-4C-2E \end{aligned}$$

$$\begin{aligned} s^4 : \quad A+B &= 0 & A &= \frac{1}{6} \\ s^3 : \quad -2B+C &= 0 & B &= -\frac{1}{6} \\ s^2 : \quad 4A+2B-2C+D &= 1 & \rightarrow & C = -\frac{2}{6} \\ s^1 : \quad -4B+2C-2D+E &= 1 & D &= 0 \\ s^0 : \quad 4A-4C-2E &= 0 & E &= \frac{6}{6} \end{aligned}$$

$$F(s) = \frac{1}{6} \left[\frac{1}{s-2} + \frac{-s-2}{s^2+2} + \frac{6}{(s^2+2)^2} \right] = \frac{1}{6} \left[\frac{1}{s-2} - \frac{s}{s^2+2} - \frac{\sqrt{2}\sqrt{2}}{s^2+2} + \frac{6 \frac{4\sqrt{2}}{4\sqrt{2}}}{(s^2+2)^2} \right]$$
$$f(t) = \boxed{\frac{1}{6} \left[e^{2t} - \cos(\sqrt{2}t) - \sqrt{2} \sin(\sqrt{2}t) + \frac{3}{2\sqrt{2}} \left(\sin(\sqrt{2}t) - \sqrt{2}t \cos(\sqrt{2}t) \right) \right]}$$