#1. (2 pts)

$$F(s)=\frac{6\sqrt{\pi}}{2s^{\frac{3}{2}}}+\frac{3(1)(3)(5)(7)}{2^4 s^{\frac{9}{2}}}-\frac{(4!)}{s^4}-\frac{2}{s}=\boxed{\frac{3\sqrt{\pi}}{s^{\frac{3}{2}}}+\frac{315}{16s^{\frac{7}{2}}}-\frac{24}{s^4}-\frac{2}{s}}$$

#4. (2 pts)

$$\boxed{H(s)=\frac{3\left(s^2-4\right)}{\left(s^2+4\right)^2}+8\frac{s\sin(1)-6\cos(1)}{s^2+36}}$$

#5. (2 pts) No partial fractions with this problem….

$$F(s)=\frac{7-8s}{2s^2-3s+1}=\frac{1}{2}\frac{7-8s}{s^2-\frac{3}{2}s+\frac{1}{2}}=\frac{1}{2}\frac{7-8s}{s^2-\frac{3}{2}s+\frac{9}{16}-\frac{9}{16}+\frac{1}{2}}=\frac{1}{2}\frac{7-8s}{\left(s-\frac{3}{4}\right)^2-\frac{1}{16}}$$

$$=\frac{1}{2}\frac{7-8s}{\left(s-\frac{3}{4}\right)^2-\frac{1}{16}}=\frac{1}{2}\left(\frac{1\frac{4}{4}}{\left(s-\frac{3}{4}\right)^2-\frac{1}{16}}-\frac{8\left(s-\frac{3}{4}\right)}{\left(s-\frac{3}{4}\right)^2-\frac{1}{16}}\right)$$

$$\boxed{f(t)=\frac{1}{2}\left(4\mathbf{e}^{\frac{3}{4}t}\sinh\left(\frac{t}{4}\right)-8\mathbf{e}^{\frac{3}{4}t}\cosh\left(\frac{t}{4}\right)\right)=2\mathbf{e}^{\frac{3}{4}t}\sinh\left(\frac{t}{4}\right)-4\mathbf{e}^{\frac{3}{4}t}\cosh\left(\frac{t}{4}\right)}$$

#6. (2 pts)

$$G(s)=\frac{A}{s}+\frac{B}{s+2}+\frac{C}{3s-4}\qquad\Rightarrow\qquad 9+7s=A(s+2)(3s-4)+Bs(3s-4)+Cs(s+2)$$

$$\begin{array}{llcl} s=0: & 9=-8A & & A=-\frac{9}{8}\\ s=-2: & -5=20B & \Rightarrow & B=-\frac{1}{4}\\ s=\frac{4}{3}: & \frac{55}{3}=\frac{40}{9}C & & C=\frac{33}{8}\end{array}$$

$$G(s)=\frac{-\frac{9}{8}}{s}-\frac{\frac{1}{4}}{s+2}+\frac{\frac{33}{8}}{3s-4}=\frac{-\frac{9}{8}}{s}-\frac{\frac{1}{4}}{s+2}+\frac{\frac{11}{8}}{s-\frac{4}{3}}\quad\Rightarrow\quad\boxed{g(t)=-\frac{9}{8}-\frac{1}{4}\mathbf{e}^{-2t}+\frac{11}{8}\mathbf{e}^{\frac{4}{3}t}}$$

#8. (2 pts)

$$H(s)=\frac{A}{s}+\frac{B}{s^2}+\frac{Cs+D}{s^2+8s+22}\ \Rightarrow\ 8+s^2=As\left(s^2+8s+22\right)+B\left(s^2+8s+22\right)+s^2\left(Cs+D\right)$$

$$=(A+C)s^3+(8A+B+D)s^2+(22A+8B)s+22B$$

$$\begin{array}{llcl} s^3: & A+C=0 & & A=-\frac{16}{121}\\ s^2: & 8A+B+D=1 & & B=\frac{4}{11}\\ s^1: & 22A+8B=0 & \Rightarrow & C=\frac{16}{121}\\ s^0: & 22B=8 & & D=\frac{205}{121}\end{array}$$

$$H(s)=\frac{1}{121}\left(\frac{-16}{s}+\frac{44}{s^2}+\frac{16s+205}{(s+4)^2+6}\right)=\frac{1}{121}\left(\frac{-16}{s}+\frac{44}{s^2}+\frac{16(s+4-4)+205}{(s+4)^2+6}\right)$$

$$=\frac{1}{121}\left(\frac{-16}{s}+\frac{44}{s^2}+\frac{16(s+4)}{(s+4)^2+6}+\frac{141\frac{\sqrt{6}}{\sqrt{6}}}{(s+4)^2+6}\right)$$

$$\boxed{h(t)=\tfrac{1}{121}\left(-16+44t+16\mathbf{e}^{-4t}\cos\left(\sqrt{6}\,t\right)+\tfrac{141}{\sqrt{6}}\mathbf{e}^{-4t}\sin\left(\sqrt{6}\,t\right)\right)}$$

Not Graded

#2.

$$\boxed{H(s)=\frac{1}{s+14}-\frac{10(s+9)}{(s+9)^2+4}-\frac{14}{s^2-4}}$$

#3.

$$\boxed{G(s)=\frac{2}{(s+1)^3}-\frac{8s}{s^2+\frac{4}{25}}-\frac{\frac{6}{5}}{s^2+\frac{4}{25}}}$$

#7.

$$H(s)=\frac{A}{s-2}+\frac{Bs+C}{s^2+8} \qquad 9s=A\left(s^2+8\right)+(s-2)(Bs+C)$$

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

$$\begin{aligned} s^2 &: \quad A+B=0 & & A=\tfrac{3}{2}\\ s^1 &: \quad -2B+C=9 & \Rightarrow \quad & B=-\tfrac{3}{2}\\ s^0 &: \quad 8A-2C=0 & & C=6 \end{aligned}$$

$$H(s)=\frac{1}{2}\left(\frac{3}{s-2}+\frac{-3s+12}{s^2+8}\right)=\frac{1}{2}\left(\frac{3}{s-2}-\frac{3s}{s^2+8}+\frac{6(2)\frac{\sqrt{2}}{\sqrt{2}}}{s^2+8}\right)$$

$$\boxed{h(t)=\tfrac{1}{2}\left(3\mathbf{e}^{2t}-3\cos\left(2\sqrt{2}\,t\right)+\tfrac{6}{\sqrt{2}}\sin\left(2\sqrt{2}\,t\right)\right)}$$

Note : I used the fact that $\sqrt{8}=2\sqrt{2}$ to “simplify” the numerator work here….

#9.

$$F(s) = \frac{A}{s-1} + \frac{Bs+C}{s^2+4} + \frac{Ds+E}{\left(s^2+4\right)^2}$$

$$\begin{aligned} 10s^2 &= A\left(s^2+4\right)^2 + (Bs+C)(s-1)\left(s^2+4\right) + (Ds+E)(s-1) \\ &= (A+B)s^4 + (-B+C)s^3 + (8A+4B-C+D)s^2 + (-4B+4C-D+E)s + 16A-4C-E \end{aligned}$$

$$\begin{array}{lrcl} s^4: & A+B=0 & & A=\tfrac{2}{5} \\ s^3: & -B+C=0 & & B=-\tfrac{2}{5} \\ s^2: & 8A+4B-C+D=10 & \Rightarrow & C=-\tfrac{2}{5} \\ s^1: & -4B+4C-D+E=0 & & D=-2 \\ s^0: & 16A-4C-E=0 & & E=8 \end{array}$$

$$\begin{aligned} F(s) &= \frac{1}{5}\left(\frac{2}{s-1} + \frac{-2s-2}{s^2+4} + \frac{-10s+40}{\left(s^2+4\right)^2}\right) \\ &= \frac{1}{5}\left(\frac{2}{s-1} - \frac{2s}{s^2+4} - \frac{2}{s^2+4} - \frac{5(2)\left(\frac{2}{2}\right)s}{\left(s^2+4\right)^2} + \frac{20(2)\left(\frac{2^3}{2^3}\right)}{\left(s^2+4\right)^2}\right) \end{aligned}$$

$$\boxed{f(t) = \tfrac{1}{5}\left(2\mathbf{e}^t - 2\cos(2t) - \sin(2t) - \tfrac{5}{2}t\sin(2t) + \tfrac{5}{2}\left(\sin(2t) - 2t\cos(2t)\right)\right)}$$