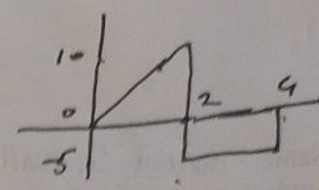


(1)

		Gradient
$= 0$	$t < 0$	$m = 0$
$f(t) = 5t$	$0 \le t < 2$	$m = 5$
$= -5$	$2 \le t < 4$	
$= 0$	$t \ge 4$	

(a) From $0 \le t < 2$

$$f(t) = 5t\,u(t) - 5(t-2)u(t-2)$$

At 2

There is a jump down from 10 to -5

There fore there is unit step $-15u(t-2)$

At $t=4$ it jumps back up to '0'. So

$+5u(t-4)$

$$\therefore\ f(t) = 5t\,u(t) - 5(t-2)u(t-2) - 15u(t-2) + 5u(t-4)$$

(b) $F(s) = \mathcal{L}\,[f(t)]$

$$= \mathcal{L}\left(5t\,u(t) - 5(t-2)u(t-2) - 15u(t-2) + 5u(t-4)\right)$$

$$= \frac{5}{s^2} - \frac{5}{s^2}e^{-2s} - \frac{15e^{-2s}}{s} + \frac{5}{s}e^{-4s}$$

(2) $\dfrac{2s+1}{s^2+4}$

(a) Find intial value of $v(t)$, $v(0^+)$

(i) $v(0^+) = \lim\limits_{s\to\infty} (V(s))\, s$ — 7.36 in the Book.

$$v(0^+) = \lim_{s\to\infty} \left[\frac{2s+1}{s^2+4}\right] s$$

$$= \lim_{s\to\infty} \left[\frac{2+1/s.}{1+4/s}\right] \frac{\cancel{s^2}}{\cancel{s^2}}$$

$$= \frac{2+0}{1+0}$$

$$v(0^+) = 2.$$

(ii) $$V(s) = \frac{2s+1}{s^2+4}$$

$$= \frac{2s}{s^2+4} + \frac{1}{s^2+4}$$

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

$$\mathcal{L}^{-1}[V(s)] = V(t)$$

$$v(t) = \left[2\cos 2t + \frac{1}{2}\sin 2t\right] u(t)$$

From Table 7.2. (8 & 9)

$v(t)$	$F(s)$
$\sin(b t)$	$\frac{b}{s^2+b^2}$
$\cos b(t)$	$\frac{s}{s^2+b^2}.$

For $R(s) > 0$.

$$v(0^+) = 2\cos(0) + \frac{1}{2}\sin 0.$$

$$= 2(1) + \frac{1}{2}(0)$$

$$= 2.$$

Same as a(i)

(b) Find Final value of $v(t)$,

(i) $\lim_{t \to \infty} x(t) = \lim_{s \to 0} s F(s)$ — 7.39 in Book.

$$\therefore \quad v(\infty) = \lim_{s \to 0} \left(\frac{2s^2 + s}{s^2 + 4} \right)$$

$$= \frac{0 + 0}{0 + 4}$$

$$v(\infty) = 0$$

(ii) $v(t) = \left[2\cos(2t) + \frac{1}{2}\sin 2t \right] u(t)$ from a(ii)

~~Ex~~ This is a non-ending periodic/osillating signal $v(\infty)$ does not exist.

The above final-value property 7.39 in b(i) is incorrect. It requires for signal $u(t)$ to give a final value. If the signal does not have a final value, then this property is not valid. $\boxed{\text{Book page 358}}$

(3)

(a) $F(s) = \dfrac{e^{-2s}}{s(s+1)} = e^{-2s}\left[\dfrac{1}{s(s+1)}\right]$

Partial Fractions for expression inside the brackets

$$\frac{1}{s(s+1)} = \left[\frac{A}{s} + \frac{B}{s+1}\right]$$

$$\frac{1}{s(s+1)} = \frac{(s+1)A + sB}{s(s+1)}$$

$\Rightarrow \quad (s+1)A + sB = 1$

For $s = 0$.

$A = 1$

For $s = -1$

$B = -1$

$\therefore \quad F(s) = e^{-2s}\left[\dfrac{1}{s} - \dfrac{1}{s+1}\right]$

$$\mathcal{L}^{-1}[F(s)] = e^{-2s}\mathcal{L}^{-1}\left[\frac{1}{s}\right] - e^{-2s}\mathcal{L}^{-1}\left[\frac{1}{s+1}\right]$$

$$= u(t-2) - e^{-(t-2)}u(t-2)$$

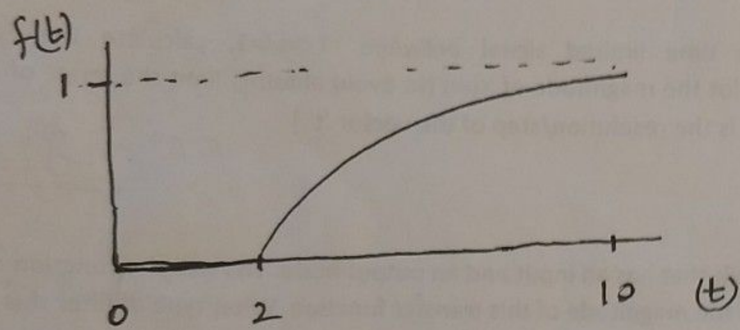
$$= \left[1 - e^{-(t-2)}\right]u(t-2)$$

Plot

befor $(t-2)$ $f(t)$ is 0

for $t=2$ $f(t)=0$.

for $t=10$ $f(t) = 0.9997$.



(b) $F(s) = \dfrac{1-e^{-s}}{s(s+1)}$

From Pratial fractions in (a)

$$F(s) = (1-e^{-s})\left[\frac{1}{s} - \frac{1}{s+1}\right]$$

$$F(s) = \left[\frac{1}{s} - \frac{1}{s+1}\right] - e^{-s}\left[\frac{1}{s} - \frac{1}{s+1}\right]$$

$$\mathcal{L}^{-1}[F(s)] = \mathcal{L}^{-1}\left[\frac{1}{s}\right] - \mathcal{L}^{-1}\left[\frac{1}{s+1}\right] - e^{-s}\mathcal{L}^{-1}\left[\frac{1}{s}\right] + e^{-s}\mathcal{L}^{-1}\left[\frac{1}{s+1}\right]$$

$$= u(t) - e^{-t}u(t) - u(t-1) + e^{-(t-1)}u(t-1)$$

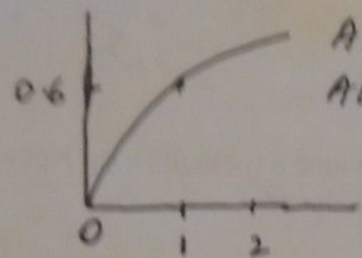
$$= (1-e^{-t})u(t) - (1-e^{-(t-1)})u(t-1)$$

Plot

$f_1(t) = 1 - e^{-t}\, u(t)$ At $t=0$, 0.

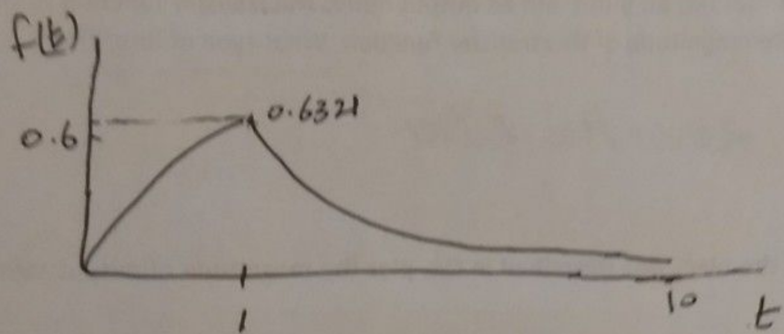
At $t=1$, 0.6321

At $t=10$, ≈ 1



$$f_2(t) = -(1-e^{-(t-1)})\,u(t-1)$$

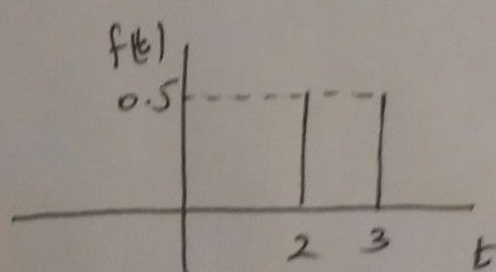
At $t=1$ $f_2(t) = 0$



(c) $F(s) = \dfrac{e^{-2s}-e^{-3s}}{2}$.

$$\mathcal{L}^{-1}F(s) = \frac{1}{2}\mathcal{L}^{-1}[e^{-2s}] - \frac{1}{2}\mathcal{L}^{-1}(e^{-3s})$$

$$= \frac{1}{2}\left(\delta(t-2) - \delta(t-3)\right).$$



(d) $F(s) = \dfrac{1-e^{-5s}}{s(s+5)} = 1-e^{-5s}\left[\dfrac{1}{s(s+5)}\right]$ (7)

Partial Fraction for expression inside the Brackets

$$\frac{1}{s(s+5)} = \frac{A}{s} + \frac{B}{s+5}$$

$$1 \equiv A(s+5) + Bs$$

for $s=0$.

$$A = \frac{1}{5}$$

For $s=-5$.

$$B = -\frac{1}{5}.$$

$$\therefore\ F(s) = (1-e^{-5s})\left[\frac{1}{5s} - \frac{1}{5(s+5)}\right]$$

$$F(s) = \left[\frac{1}{5s} - \frac{1}{5(s+5)}\right] - e^{-5s}\left(\frac{1}{5s} - \frac{1}{5(s+5)}\right]$$

$$\mathcal{L}^{-1}[F(s)] = \mathcal{L}^{-1}\left(\frac{1}{5s}\right) - \mathcal{L}^{-1}\left[\frac{1}{5(s+5)}\right] - e^{-5s}\mathcal{L}^{-1}\left[\frac{1}{5s}\right] + e^{-5s}\mathcal{L}^{-1}\left[\frac{1}{5(s+5)}\right]$$

$$= \frac{u(t)}{5} - \frac{e^{-5t}u(t)}{5} - \frac{u(t-5)}{5} + e^{-5(t-5)}u(t-5)$$

$$= \frac{1}{5}\left[(1-e^{-5t})u(t) - (1-e^{-5(t-5)})u(t-5)\right]$$

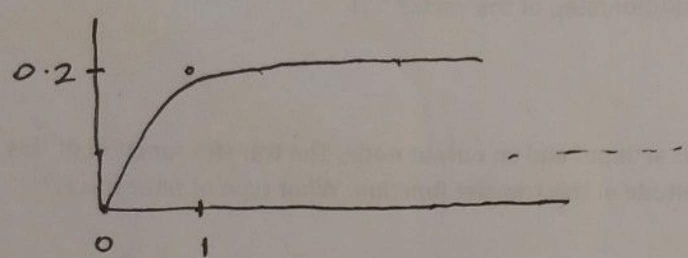
Plot.

$$f_1(t) = \frac{1}{5}(1-e^{-5t})$$

At $t=0$, 0.

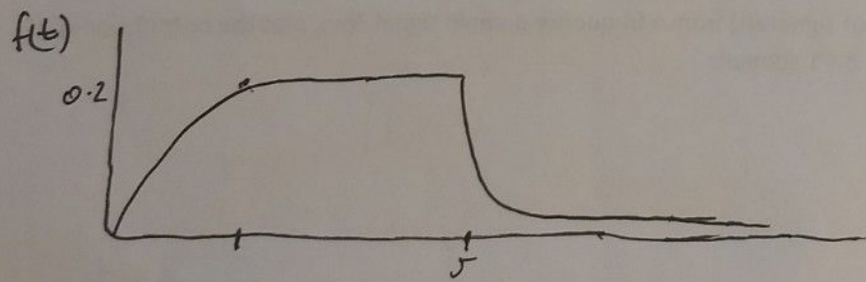
$t=1$, $0.99/5 \approx 0.2$

$t=2$, $\approx 1 \approx 0.2$.



$$f_2(t) = \frac{-1}{5}(1-e^{-5(t-5)})\,u(t-5).$$

At $t=5$, $f_2(t) \approx 0$



(4)

(i) $\frac{d^2}{dt^2} y(t) + 5 \frac{d\,y(t)}{dt} + 4\,y(t) = 2\,x(t)$.

(a) impulse response.

$s^2 Y(s) + 5s\, Y(s) + 4Y(s) = 2X(s)$.

For impulse response $X(s) = 1$

$$H(s) = \frac{Y(s)}{X(s)} = \frac{2}{s^2+5s+4}$$

$$= \frac{2}{s^2+4s+1s+4}$$

$$= \frac{2}{(s+4)(s+1)}$$

Partial Fractions.

$$\frac{2}{(s+4)(s+1)} = \frac{2A}{s+4} + \frac{2B}{s+1}$$

$2 \equiv 2A(s+1) + 2B(s+4)$.

$s = -1$

$2 = 2B(3)$

$B = \frac{1}{3}$

$s = -4$

$2 = 2A(-3)$

$A = -\frac{1}{3}$

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

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

$$\boxed{h(t) = \frac{2}{3}\left(e^{-t} - e^{-4t}\right)}$$

(b) $\frac{d^2}{dt^2}y(t) + 5\frac{dy(t)}{dt} + 4y(t) = 2x(t)$

For unit step $x(t) = u(t)$

& $\mathcal{L}\, u(t) = \frac{1}{s}$

$\therefore\ X(s) = \frac{1}{s}$.

From (a)

$$S(s) = \frac{Y(s)}{X(s)} = \frac{2}{s^2+5s+4}$$

$$S(s) = sY(s) = \frac{2}{(s+4)(s+1)}$$

$$S(s) = \frac{2}{s(s+1)(s+4)}$$

Partial Fractions.

$$\frac{2}{s(s+1)(s+4)} \equiv \frac{2A}{s} + \frac{2B}{s+1} + \frac{2C}{s+4}$$

$$2 = 2A(s+1)(s+4) + 2Bs(s+4) + 2Cs(s+1)$$

For $s=0$

$$2 = 2A(1)(4).$$

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

For $s=-1$

$$2 = 2B(-1)(3)$$

$$B = -\frac{1}{3}.$$

For $s=-4$.

$$2 = 2C(-4)(-3).$$

$$C = \frac{1}{12}.$$

$$S(s) = \frac{1}{2s} - \frac{2}{3(s+1)} + \frac{1}{6(s+4)}$$

$$\mathcal{L}^{-1} S(s) = \frac{1}{2}\mathcal{L}^{-1}\left[\frac{1}{s}\right] - \frac{2}{3}\mathcal{L}^{-1}\left[\frac{1}{s+1}\right] + \frac{1}{6}\mathcal{L}^{-1}\left[\frac{1}{s+4}\right]$$

$$s(t) = \left[\frac{1}{2} - \frac{2}{3}e^{-t} + \frac{1}{6}e^{-4t}\right] u(t).$$

(c) $h(t) = \frac{d\, s(t)}{dt}$.

$$\frac{d\, s(t)}{dt} = \frac{d}{dt}\left[\frac{1}{2} - \frac{2}{3}e^{-t} + \frac{1}{6}e^{-4t}\right]$$

$$= \frac{2}{3}e^{-t} - \frac{4}{6}e^{-4t}$$

$$\frac{d\, s(t)}{dt} = \frac{2}{3}\left(e^{-t} - e^{-4t}\right) = h(t)$$

Hence varified.

(ii) $$\frac{d^2}{dt^2}y(t) + 5\frac{d\, y(t)}{dt} + 4y(t) = 2\frac{d\, x(t)}{dt} + 6x(t)$$

(a) impulse Response

$$s^2 Y(s) + 5s\, Y(s) + 4\, Y(s) = 2s X(s) + 6 X(s)$$

$$H(s) = \frac{Y(s)}{X(s)} = \frac{(2s+6)}{(s^2+5s+4)}$$

$$= \frac{2s+6}{(s+1)(s+4)}$$

$$(2s+6) = A(s+4) + B(s+1)$$

$s = -4.$

$-8+6 = -3B.$

$B = \frac{2}{3}.$

$s = -1$

$4 = 3A$

$A = \frac{4}{3}.$

$$H(s) = \frac{4/3}{s+1} + \frac{2/3}{(s+4)}$$

$$h(t) = \mathcal{L}^{-1}\left[H(s)\right] = \frac{4}{3}e^{-t} + \frac{2}{3}e^{-4t}.$$

$$\boxed{h(t) = \frac{2}{3}\left(2e^{-t} + e^{-4t}\right)}$$

(b) $S(s) = sY(s) = \dfrac{2s+6}{(s+1)(s+4)}$

$S(s) = Y(s) = \dfrac{2s+6}{s(s+1)(s+4)}$

$$\frac{2s+6}{(s+1)(s+4)} = \frac{A}{s} + \frac{B}{(s+1)} + \frac{C}{s+4}$$

(iii) $\frac{d^3}{dt^3} y(t) + 3 \frac{d^2}{dt^2} y(t) + 4 \frac{d}{dt} y(t) + 2\, y(t) = 6\, x(t).$

(a) $s^3 Y(s) + 3s^2 Y(s) + 4s\, Y(s) + 2\, Y(s) = 6\, X(s).$

$$\frac{Y(s)}{X(s)} = \frac{6}{s^3+3s^2+4s+2}$$

$$H(s) = \frac{6}{(s+1)(s+(1+j))(s+(1-j))}$$

$$H(s) = \frac{A}{(s+1)} + \frac{B}{(s+(1+j))} + \frac{C}{(s+(1-j))}.$$

$$6 = A(s+(1+j))(s+(1-j)) + B(s+1)(s+(1-j)) + C(s+1)(s+(1+j))$$

$s=-1.$

$A(-1+1+j)(-1+1-j) = 6$

$A = +6.$

$s = -1-j$

$B(-1+1-j)(-1+1-j-j) = 6.$

$B(-j)(-2j) = 6.$

$B = \frac{6}{2j^2} = -3$

$s = -1+j$

$C(j)(2j) = 6 \Rightarrow C = -3$

$$2s+6 = A(s+1)(s+4) + Bs(s+4) + Cs(s+1)$$

$s=0$

$$6 = A(1)(4).$$

$$A = \frac{3}{2}.$$

$s=-1$

$$4 = B(-1)(+3).$$

$$B = -\frac{4}{3}$$

$s=-4.$

$$-2 = C(-4)(-3).$$

$$C = -\frac{1}{6}.$$

$$S(s) = \frac{3}{2s} - \frac{4}{3(s+1)} - \frac{1}{6(s+4)}$$

$$\mathcal{L}^{-1}[S(s)] = \left[\frac{3}{2} - \frac{4}{3}e^{-t} - \frac{1}{6}e^{-4}\right] u(t).$$

(c) $$\frac{d\,s(t)}{dt} = \frac{d}{dt}\left[\frac{3}{2}\right] - \frac{4}{3}\frac{d}{dt}e^{-t} - \frac{1}{6}\frac{d}{dt}e^{-4}$$

$$\boxed{\frac{d\,s(t)}{dt} = \frac{4}{3}e^{-t} + \frac{2}{3}e^{-4} = h(t)}$$

(iii) $\frac{d^3}{dt^3} y(t) + 3 \frac{d^2}{dt^2} y(t) + 4 \frac{d}{dt} y(t) + 2 y(t) = 6 x(t).$

(a) $s^3 Y(s) + 3s^2 Y(s) + 4s \cdot Y(s) + 2 Y(s) = 6 X(s).$

$$\frac{Y(s)}{X(s)} = \frac{6.}{s^3+3s^2+4s+2}$$

$$H(s) = \frac{6}{(s+1)(s+(1+j))(s+(1-j))}$$

$$H(s) = \frac{A}{(s+1)} + \frac{B}{(s+(1+j))} + \frac{C}{(s+(1-j))}.$$

$$6 = A(s+(1+j))(s+(1-j)) + B(s+1)(s+(1-j)) + C(s+1)(s+(1+j))$$

$s=-1.$

$A(-1+1+j)(-1+1-j) = 6$

$A = +6.$

$s = -1-j$

$B(-1+1-j)(-1+1-j-j) = 6.$

$B(-j)(-2j) = 6.$

$B = \frac{6}{2j^2} = -3$

$s = -1+j$

$C(j)(2j) = 6 \Rightarrow C = -3$

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$$H(s) = \frac{6}{(s+1)} - \frac{3}{(s+1+j)} - \frac{3}{(s+1-j)}$$

$$\mathcal{L}^{-1}[H(s)] = 6e^{-t} - 3e^{(-1-j)t} - 3e^{(-1+j)t}$$

$$= 6e^{-t} - 3e^{-t}\left(\frac{e^{-jt} + e^{jt}}{2}\right) \times 2$$

$$\boxed{h(t) = 6e^{-t} - 6e^{-t}\cos(t)}$$

(b) $$S(s) = \frac{6}{s(s+1)(s^2+2s+2)}$$

$$S(s) = \frac{A}{s} + \frac{B}{s+1} + \frac{Cs+D}{(s^2+2s+2)}$$

$$6 = A(s+1)(s^2+2s+2) + B(s)(s^2+2s+2) + (Cs+D)(s)(s+1)$$

$s=0$

$6 = A(1)(2)$

$A = 3$

$s=-1$

$B(-1)(1-2+2) = 6$

$B = -6$

$s = 1$

$6 = 3(2)(5) - 6(1)(5) + Cs+D(2)$

$3 = 30 - 30 + C + D$

$\boxed{C = 3 - D}$ — 1

$s = 2.$

$6 = 3\times3\times10 - 6\times2\times10 + 6(2C+D)$

$6(2C+D) + 90 - 120 = 6$

$6(2C+D) = 36$

$2C + D = 6$

put 1.

$6 - 2D + D = 6 \Rightarrow D = 0$

$C = 3.$

$$\therefore S(s) = \frac{3}{s} - \frac{6}{s+1} + \frac{3s}{(s+1)^2+1}$$

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

(17)

$$S(s) = \frac{3}{s} - \frac{6}{s+1} + \frac{3(s+1)}{(s+1)^2+1} - \frac{3(1)}{(s+1)^2+1}$$

$$\boxed{s(t) = u(t)\left(3 - 6e^{-t} + 3e^{-t}\cos t - 3e^{-t}\sin t\right)}$$

(c) $\frac{d}{dt}s(t) = 6e^{-t} - 3e^{-t}\cos t - \cancel{3e^{-t}\sin t} + \cancel{3e^{-t}\sin t} - 3e^{-t}\cos t$

$$\boxed{\frac{d}{dt}s(t) = 6e^{-t} - 6e^{-t}\cos t = h\,t}$$

Hence varified

(iv) $\frac{d^3}{dt^3}y(t) - \frac{d^2}{dt^2}y(t) + 2y(t) = 4\frac{dx(t)}{dt} - 8x(t)$

Impulse Response

(a) $s^3 Y(s) - s^2 Y(s) + 2Y(s) = 4s X(s) - 8X(s)$

$$\frac{Y(s)}{X(s)} = \frac{4s-8}{s^3-s^2+2}.$$

$$H(s) = \frac{4s-8}{(s+1)(s^2-2s+2)}$$

$$H(s) = \frac{A}{s+1} + \frac{Bs+C}{(s^2-2s+2)}$$

$$4s-8 = A(s^2-2s+2) + (Bs+C)(s+1)$$

$s=-1$

$-4-8 = A(1+2+2)$

$\frac{-12}{5} = A$

$s=0$

$-8 = \frac{-24}{5} + C$

$\frac{24-40}{5} = C$

$C = \frac{-16}{5}$

$s=1$

$4-8 = \frac{-12}{5} + 2B + 2C$

$-4 + \frac{12}{5} - 2C = 2B.$

$\frac{-20+12+32}{10} = B$

$B = 24/10 = \frac{12}{5}$

$\therefore H s = \frac{-12}{5(s+1)} + \frac{(\frac{12}{5}s - 16/5)}{(s^2-1)+1}$

(19)

$$H(s) = \frac{-12}{5(s+1)} + \frac{12}{5}\frac{s}{(s-1)^2+1} - \frac{16/5}{(s-1)^2+1}$$

$$= \frac{-12}{5(s+1)} + \frac{12}{5}\frac{[(s-1)+1]}{(s-1)^2+1} - \frac{16/5}{(s-1)^2+1}$$

$$H(s) = \frac{-12}{5(s+1)} + \frac{12}{5}\frac{(s-1)}{(s-1)^2+1} + \frac{\frac{12}{5}-16/5}{(s-1)^2+1}$$

$$h(t) = \mathcal{L}^{-1}[H(s)] = \frac{-12}{5}e^{-t} + \frac{12}{5}e^{t}\cos(t) - \frac{4}{5}e^{t}\sin(t)$$

(b) $\frac{Y(s)}{X(s)} = \frac{4s-8}{(s+1)(s^2-2s+2)}$

For unit step $X(s) = \frac{1}{s}$.

$$S(s) = \frac{Y(s)}{1/s} = \frac{4s-8}{(s+1)(s^2-2s+2)}$$

$$S(s) = \frac{4s-8}{(s)(s+1)(s^2-2s+2)}$$

$$S(s) = \frac{A}{s} + \frac{B}{s+1} + \frac{Cs+D}{s^2-2s+2}$$

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$$4s-8 = A(s+1)(s^2-2s+2) + B(s)(s^2-2s+2) + (Cs+D)(s)(s+1)$$

$\boxed{s=0}$.

$$-8 = A(1)(2).$$

$$A = -4$$

$\boxed{s=-1}$

$$-12 = -B(1+2+2).$$

$$B = \frac{12}{5}$$

$\boxed{s=1}$

$$-4 = -4(2)(1-2+2) + \frac{12}{5}(1-2+2) + (C+D)(1)(2)$$

$$-4 = -8 + \frac{12}{5} + 2(C+D)$$

$$4 - \frac{12}{5} = 2(C+D)$$

$$\boxed{\frac{8}{10} = C+D} \Rightarrow \boxed{D = \frac{8}{10} - C} \quad — (1).$$

$\boxed{s=2}$

$$0 = -4(3)(4-4+2) + \frac{12}{5}(2)(4-4+2) + (2C+D)(6)$$

$$0 = -24 + \frac{48}{5} + (2C+D)6.$$

$$24 - \frac{48}{5} = (2C+D)6.$$

$$\frac{72}{5} = (2C+D)6.$$

$$\frac{72}{30} = 2C + D$$

Put 1

$$\frac{7.2}{30} = 2C + \frac{8}{10} - C$$

$$\frac{7.2}{30} = \frac{10C+8}{10}$$

$$\frac{7.2}{3} = 10C + 8$$

$$\frac{7.2 - 24}{30} = C$$

$$C = \frac{7.8}{30} = \frac{16}{10} = \frac{8}{5}$$

$$D = \frac{8}{10} - \frac{8}{5}$$

$$= -\frac{8}{10} = -\frac{4}{5}$$

$$S(s) = \frac{-4}{s} + \frac{12}{5(s+1)} + \frac{8s}{5(s^2-2s+2)} - \frac{4/5}{(s^2-2s+2)}$$

$$\mathcal{L}^{-1} S(s) = \mathcal{L}^{-1}\left[\frac{-4}{s}\right] + \mathcal{L}^{-1}\left[\frac{12}{5(s+1)}\right] + \frac{8}{5}\mathcal{L}^{-1}\left[\frac{s-1+1}{(s-1)^2+1}\right] - \frac{4}{5}\mathcal{L}^{-1}\left[\frac{1}{(s-1)^2+1}\right]$$

$$s(t) = \left(-4 + \frac{12}{5}e^{-t} + \frac{8}{5}e^{t}\cos t + \frac{4}{5}\cdot e^{t}\sin t\right)u(t)$$

$$\frac{d\,s(t)}{dt} = -\frac{12}{5}e^{-t} + \frac{8}{5}e^{t}\cos t - \frac{8}{5}e^{t}\sin t + \frac{4}{5}e^{t}\sin(t) + \frac{4}{5}e^{t}\cos t$$

$$= -\frac{12e^{-t}}{5} + \frac{12e^{t}\cos t}{5} - \frac{4}{5}e^{t}\sin(t)$$

Hence Varified