1. PR11.12d $\frac{(s+a)e^{-as}}{s+b}$

$$\require{enclose}\begin{array}{r}1\\ s+b\;\enclose{longdiv}{s+a}\\ \underline{s+b}\\ a-b\end{array}$$

$$= \left(1+\frac{a-b}{s+b}\right)e^{-as} \longrightarrow \underline{\underline{\delta(t-a)+(a-b)e^{-b(t-a)}u(t-a)}}$$

2. PR11.13b $\frac{4(s^2+1)}{s(s^2+4)} = \frac{K_1}{s}+\frac{K_2 s+K_3}{(s+0)^2+2^2}$ $\rightarrow K_1 = 1$

$4s^2+1 = 1(s^2+4)+K_2 s^2+K_3 s$

$s^2: 4 = 1+K_2 \Rightarrow K_2 = 3$

$s: 0 = K_3$

$$= \frac{1}{s}+\frac{3s}{s^2+2^2} \longrightarrow \underline{\underline{u(t)+3\cos(2t)u(t)}}$$

3. a) $\frac{d^2x}{dt^2}+8\frac{dx}{dt}+15x = (t-1)u(t-1)$, $x(0)=1$, $\frac{dx(0)}{dt}=2$

$LT \Rightarrow \left[s^2X(s)-sx(0)-\frac{dx(0)}{dt}\right]+8\left[sX(s)-x(0)\right]+15X(s) = \frac{1}{s^2}\left(e^{-s}\right)$

$\Rightarrow X(s)(s^2+8s+15)-s-2-8 = \frac{1}{s^2}e^{-s}$

$\Rightarrow X(s)(s^2+8s+15) = s+10+\frac{1}{s^2}e^{-s}$

$\Rightarrow X(s) = \frac{s+10}{s^2+8s+15}+\frac{1\,e^{-s}}{s^2(s^2+8s+15)} = \frac{3.5}{s+3}-\frac{2.5}{s+5}+e^{-s}\left[\underbrace{\frac{-.0356}{s}}_{\frac{-8}{225s}}+\underbrace{\frac{.0667}{s^2}}_{\frac{1}{15s^2}}+\underbrace{\frac{.0556}{s+3}}_{\frac{1}{18(s+3)}}-\underbrace{\frac{.02}{s+5}}_{\frac{-1}{50(s+5)}}\right]$

$$\Rightarrow x(t) = \left(3.5e^{-3t}-2.5e^{-5t}\right)u(t) + \big(\underbrace{-.0356}_{\frac{-8}{225}}+\underbrace{.0667}_{\frac{1}{15}}(t-1)+\underbrace{.0556}_{\frac{1}{18}}e^{-3(t-1)}-\underbrace{.02}_{\frac{-1}{50}}e^{-5(t-1)}\big)u(t-1)$$

b) $\frac{d^2x}{dt^2}+6\frac{dx}{dt}+9x = 3u(t)$, $x(0)=1$, $\frac{dx(0)}{dt}=2$

$LT \Rightarrow \left[s^2X(s)-s(1)-2\right]+6\left[sX(s)-1\right]+9X(s) = \frac{3}{s}$

$\Rightarrow X(s)(s^2+6s+9) = s+2+6+\frac{3}{s} = \frac{s^2+8s+3}{s}$

$\Rightarrow X(s) = \frac{s^2+8s+3}{s(s+3)^2} = \frac{K_1}{s}+\frac{K_2}{s+3}+\frac{K_3}{(s+3)^2} = \frac{\frac{1}{3}}{s}+\frac{\frac{2}{3}}{s+3}+\frac{4}{(s+3)^2}$

$$\Rightarrow \underline{\underline{x(t) = \left(\tfrac{1}{3}+\tfrac{2}{3}e^{-3t}+4te^{-3t}\right)u(t)}}$$

c) $\frac{d^2x}{dt^2}+4\frac{dx}{dt}+20x = 2u(t)$, $x(0)=1$, $\frac{dx(0)}{dt}=2$

$LT \Rightarrow \left[s^2X(s)-s(1)-2\right]+4\left[sX(s)-1\right]+20X(s) = \frac{2}{s}$

$\Rightarrow X(s)(s^2+4s+20) = s+6+\frac{2}{s} = \frac{s^2+6s+2}{s}$

$\Rightarrow X(s) = \frac{s^2+6s+2}{s(s^2+4s+20)} = \frac{s^2+6s+2}{s(s+2+j4)(s+2-j4)} = \frac{K_1}{s}+\frac{K_2 s+K_3}{(s+2)^2+4^2}$

$\rightarrow K_1 = \frac{1}{10}$; $s^2+6s+2 = \frac{1}{10}(s^2+4s+20)+K_2 s^2+K_3 s$

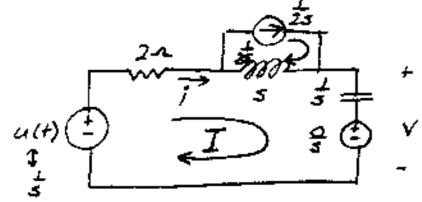
$s^2: 1 = \frac{1}{10}+K_2 \Rightarrow K_2 = 9/10$

$s: 6 = \frac{4}{10}+K_3 \Rightarrow K_3 = \frac{60}{10}-\frac{4}{10} = \frac{56}{10}$

$\frac{1}{10s}+\frac{(9/10)s+56/10}{(s+2)^2+4^2} = \frac{1}{10}\left(\frac{1}{s}+\frac{9(s+2)}{(s+2)^2+4^2}+\frac{9.5(4)}{(s+2)^2+4^2}\right)$

$$\left.\begin{aligned}\Rightarrow x(t) &= \tfrac{1}{10}\left(1+9e^{-2t}\cos(4t)+9.5e^{-2t}\sin(4t)\right)u(t)\\ &= \left(0.1+0.9e^{-2t}\cos(4t)+0.95e^{-2t}\sin(4t)\right)u(t)\\ &= \underline{\underline{\left(0.1+1.31e^{-2t}\cos(4t-46.5^\circ)\right)u(t)}}\end{aligned}\right\}\text{all ok}$$

4. PR 11.36



mesh current: $-\frac{1}{s} + 2I + s\left(I - \frac{1}{2s}\right) + \frac{1}{s}I + 0 = 0$

$$\Rightarrow I\left(2 + s + \frac{1}{s}\right) = \frac{1}{s} + \frac{1}{2} = \frac{1 + (\frac{1}{2})s}{s}$$

$$\Rightarrow I(s^2 + 2s + 1) = \tfrac{1}{2}s + 1$$

$$\Rightarrow I = \frac{\frac{1}{2}s + 1}{s^2 + 2s + 1} = \frac{\frac{1}{2}s + 1}{(s+1)^2}$$

$$V(s) = \frac{1}{s}I(s) + \frac{0}{s}$$

$$= \frac{\frac{1}{2}s + 1}{(s+1)^2 s} = \frac{K_1}{s} + \frac{K_2}{(s+1)} + \frac{K_3}{(s+1)^2}$$

$\rightarrow K_1 = 1$

$\rightarrow K_3 = \frac{-\frac{1}{2} + 1}{-1} = -\frac{1}{2}$

$\rightarrow s = 1: \; \frac{\frac{1}{2} + 1}{4} = \frac{1}{1} + \frac{K_2}{2} + \frac{(-\frac{1}{2})}{4}$

$\Rightarrow \frac{3}{2} = 4 + 2K_2 - \frac{1}{2}$

$\Rightarrow \frac{4}{2} - 4 = 2K_2$

$\Rightarrow -2 = 2K_2$

$\Rightarrow K_2 = -1$

$$\Rightarrow v(t) = u(t) - e^{-t}u(t) - \tfrac{1}{2}te^{-t}u(t)$$

$$= \left(1 - e^{-t} - \tfrac{1}{2}te^{-t}\right)u(t) \quad \text{V}$$