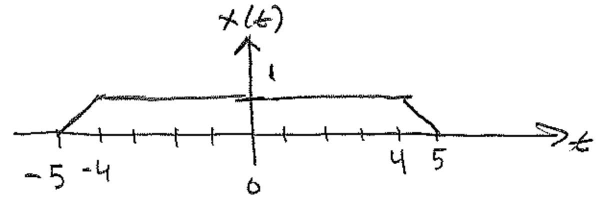
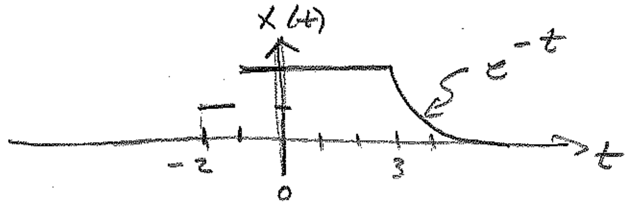
1) a)



b)



2)

a) $x(t) = r(t+2) - r(t+1) - 2u(t) + r(t-1) - r(t-2)$

• written piecewise

$$x(t) = \begin{cases} t+2 & -2<t<-1 \\ 1 & -1<t<0 \\ -1 & 0<t<1 \\ t-2 & 1<t<2 \\ 0 & \text{else} \end{cases}$$

• Taking magnitude squared

$$|x(t)|^2 = \begin{cases} (t+2)^2 & -2<t<-1 \\ 1 & -1<t<0 \\ 1 & 0<t<1 \\ (t-2)^2 & 1<t<2 \\ 0 & \text{else} \end{cases}$$

• Integrating each piece.

$$E_x = \int_{-2}^{-1} (t+2)^2\,dt + \int_{-1}^{0} dt + \int_{0}^{1} dt + \int_{1}^{2} (t-2)^2\,dt$$

$$= \frac{1}{3}t^3 + 2t^2 + 4t \Big|_{-2}^{-1} + t \Big|_{-1}^{0} + t \Big|_{0}^{1} + \frac{1}{3}t^3 - 2t^2 + 4t \Big|_{1}^{2}$$

$$\boxed{E_x = \frac{8}{3}}$$

② b) $x(t) = u(t+2) - u(t-1)$

$$E_x = \int_{-2}^{1} dt = t\Big/_{-2}^{1} = 1+2 = 3 \qquad \boxed{E_x = 3}$$

③

$$y(t) = \sum_{n=-\infty}^{\infty} x(t-5n) \qquad x(t) = u(t+2) - u(t-1)$$

is periodic with period $T=5$

Thus $P_y = \frac{1}{T}\int_T |x(t)|^2\,dt$

$$= \frac{1}{5}\int_{-2}^{1} dt = \frac{1}{5}(1+2) = \frac{3}{5} \qquad \boxed{P_y = \frac{3}{5}}$$

④

$$x(t) = \frac{1}{2+\cos(2\pi t)}$$

- $\cos(2\pi t)$ is periodic with $T=1$
- Let $g(z) = \frac{1}{2+z}$ then $x(t) = g(\cos(2\pi t))$ is also periodic with $T=1$

Since $x(t)$ is periodic $E_x = \infty$

$$P_x = \frac{1}{T}\int_T \frac{1}{(2+\cos(2\pi t))^2}\,dt = \frac{2}{3\sqrt{3}} \quad \text{(using Computer)}$$

$$\approx 0.385$$

Thus $x(t)$ is a Power Signal.

⑤ a) $x(t) = 2\cos(10t+1)$ is periodic with Period

$$\boxed{T = \frac{2\pi}{10}}$$

- The power integral is in Integration Table, as

$$\int \cos^2(\omega t+\phi)\,dt = \frac{2(\phi+\omega t)+\sin(2\omega t+2\phi)}{4\omega}$$

In our case $P_x = \frac{10}{2\pi}\int_0^{2\pi/10} 4\cos^2(10t+1)\,dt$

$$= \frac{20}{\pi}\left[\frac{2(10t+1)+\sin(20t+2)}{40}\right]_0^{2\pi/10}$$

$$\boxed{P_x = 2}$$

5.b) $x(t) = \underbrace{\cos(3\pi t)}_{T_1 = \frac{2}{3}} + 2j\sin\underbrace{(6t)}_{T_2 = \pi/3}$

There are no integers a, b such that $aT_1 = bT_2$ since π is irrational

Thus $x(t)$ is not periodic.

5.e) $x(t) = 2\underbrace{\cos(\pi t+2)}_{T_1 = 2} + \sin(3\pi t)$ $\quad T_2 = \frac{2}{3}$

$aT_1 = bT_2 = 2$ when $a=1$, $b=3$ thus $x(t)$ is periodic with period $T = 2$

$P_x = \frac{1}{2}\int_0^2 |x(t)|^2 dt$ and $|x(t)|^2 = (2\cos(\pi t+2) + \sin(3\pi t))^2$

$= 4\cos^2(\pi t+2) + 4\sin(3\pi t)\cos(\pi t+2) + \sin^2(3\pi t)$

$= \frac{1}{2}\int_0^2 4\cos^2(\pi t+2)\,dt$

$+ \frac{1}{2}\int_0^2 4\sin(3\pi t)\cos(\pi t+2)\,dt$

$+ \frac{1}{2}\int_0^2 \sin^2(3\pi t)\,dt$

- the integral of $\sin^2$ or $\cos^2$ over 1 period is 1
- The integral of an odd periodic function is 0,

Thus the $\int \sin(3\pi t)\cos(\pi t+2)dt$ is 0,

So $P_x = \frac{1}{2}\left[4 + 0 + 1\right] = \boxed{\frac{5}{2}}$

6a)

$$x_e(t) = \frac{1}{2}\left[x(t) + x(-t)\right]$$

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

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

$$x_o(t) = \frac{1}{2}\left[x(t) - x(-t)\right] = \underline{\frac{3}{2}u(-t) - \frac{3}{2}u(t)}$$

b) $x(t) = \cos(2\pi t + \pi/4)$

$$= \cos\frac{\pi}{4}\cos(2\pi t) - \sin\frac{\pi}{4}\sin(2\pi t) \quad \text{Trig identity}$$

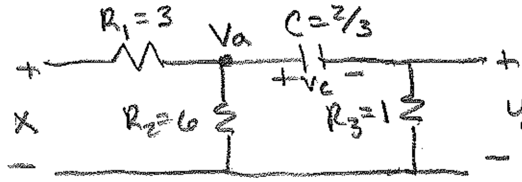
$\boxed{x_e = \cos\frac{\pi}{4}\cos(2\pi t)}$ by inspection, cos is even.

$\boxed{x_o = \sin\frac{\pi}{4}\sin(2\pi t)}$ by inspection, sin is odd

c) $x(t) = \dfrac{1}{1+t^2}$, $x_o = \dfrac{1}{2}\left[\dfrac{1}{1+t^2} - \dfrac{1}{1+t^2}\right] = \underline{0}$

Thus $x(t)$ is even, $x_e(t) = x(t) = \dfrac{1}{1+t^2}$

(7)



a) $\dfrac{x - V_a}{R_1} = \dfrac{V_a}{R_2} + C V_c'$ KCL @ Node a.

$V_a = V_c + R_3 C V_c'$ KVL around Va−y−0

substituting and simplify

$$V_c' + \frac{R_1 + R_2}{R_1 R_2 C + (R_1+R_2) R_3 C} V_c = \frac{R_2}{R_1 R_2 C + (R_1+R_2) C R_3} x$$

This is the equation relating x to V_c

By ohms Law $y = R_3 C V_c'$ relates V_c to y.

b) Substituting numerical values

Eq(1) $V_c' + \frac{1}{2} V_c = \frac{1}{3} x$ and Eq(2) $y = \frac{2}{3} V_c'$

The solution to (1) is $V_c = \frac{1}{3} e^{-\frac{1}{2}t} \int_{-\infty}^{t} e^{\frac{1}{2}\tau} x(\tau)\, d\tau$

where $x(\tau) = \begin{cases} 0 & \tau < -2 \\ 1 & -2 < \tau < 1 \\ 0 & \tau > 1 \end{cases}$

- for $\tau < -2$ $V_c = 0$, the system is at rest
- for $-2 < \tau < 1$

$$V_c = \frac{1}{3} e^{-\frac{1}{2}t} \int_{-2}^{t} e^{\frac{1}{2}\tau} d\tau = \frac{2}{3} e^{-\frac{1}{2}t} \left[e^{\frac{1}{2}t} - e^{-1} \right]$$

$$= \frac{2}{3} - \frac{2}{3} e^{-\frac{1}{2}t - 1}$$

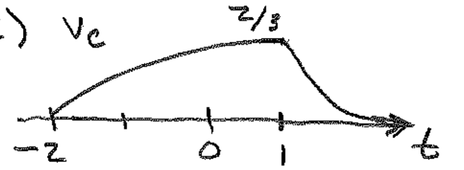
- for $\tau > 1$

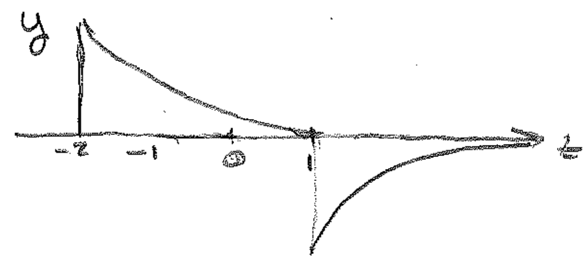
$$V_c = \frac{1}{3} e^{-\frac{1}{2}t} \int_{-2}^{1} e^{\frac{1}{2}\tau} d\tau = \frac{2}{3} \left(e^{\frac{1}{2}} - e^{-1} \right) e^{-\frac{1}{2}t}$$

7 b) cont. reassembling the piecewise solution.

$$V_c(t) = \begin{cases} 0 & t < -2 \\ \frac{2}{3} - \frac{2}{3} e^{-\frac{1}{2}t - 1} & -2 < t < 1 \\ \frac{2}{3} - \frac{2}{3}\left(e^{\frac{1}{2}} - e^{-1}\right) e^{-\frac{1}{2}t} & t > 1 \end{cases}$$

$$y = \frac{2}{3} v_c' = \begin{cases} 0 & t < -2 \\ \frac{2}{9} e^{-\frac{1}{2}t - 1} & -2 < t < 1 \\ -\frac{2}{9}\left(e^{\frac{1}{2}} - e^{-1}\right) e^{-\frac{1}{2}t} & t > 1 \end{cases}$$

c) 



d) We can re-write the piecewise functions using steps.

$$\boxed{V_c(t) = \left[\frac{2}{3} - \frac{2}{3} e^{-\frac{1}{2}t - 1}\right]\left[u(t+2) - u(t-1)\right] + \left[\frac{2}{3}\left(e^{\frac{1}{2}} - e^{-1}\right) e^{-\frac{1}{2}t}\right] u(t-1)}$$

AND

$$\boxed{y(t) = \left[\frac{2}{9} e^{-\frac{1}{2}t - 1}\right]\left[u(t+2) - u(t-1)\right] + \left[-\frac{2}{9}\left(e^{\frac{1}{2}} - e^{-1}\right) e^{-\frac{1}{2}t}\right] u(t-1)}$$

(8) a) $5y'' + 2y' + 9y = x$

- linear if No I.C. because it is a LCCDE.
- time invariant, no coefficient is a function of t
- dynamic.

b) $y = t^2 x$ is linear, time varying, instantaneous

c) $y' + y^2 = x$ is nonlinear, time invariant, dynamic

d) $y'' + y' - ty = x' - 2x$ is linear, time-varying, dynamic

Only a) corresponds to an LTI system

---

(9) $y'' + 9y' + 20y = x \qquad y'(0^-) = 0 \quad y(0^-) = 2$

$Q(D) = D^2 + 9D + 20 \quad = D^2 + a_1 D + a_2$

$P(D) = 0D^2 + 0D + 1 \quad = b_0 D^2 + b_1 D + b_2$

a) Q(D) has 2 roots $-4, -5$

$y_0(t) = c_1 e^{-4t} + c_2 e^{-5t} \qquad y(0^-) = c_1 + c_2 = 2$

$y_0' = -4c_1 e^{-4t} - 5c_2 e^{-5t} \qquad \underbrace{y'(0^-) = -4c_1 - 5c_2 = 0}_{c_1 = 10 \quad c_2 = -8}$

$$\boxed{y_0(t)u(t) = (10e^{-4t} - 8e^{-5t})u(t)}$$

b) $y_n = c_1 e^{-4t} + c_2 e^{-5t} \qquad y_n'(0^+) = 1 \quad y_n(0^+) = 0$

$y_n' = -4c_1 e^{-4t} - 5c_2 e^{-5t}$

$$\left.\begin{aligned} y_n(0^+) &= c_1 + c_2 = 0 \\ y_n'(0^+) &= -4c_1 - 5c_2 = 1 \end{aligned}\right\} \quad c_1 = 1 \quad c_2 = -1$$

$h(t) = \underset{\overset{\shortparallel}{0}}{b_0}\,\delta(t) + [P(D)y_n]u(t)$

$$\boxed{h(t) = (e^{-4t} - e^{-5t})u(t)}$$

9, c) $x(t) = te^{-t}u(t)$ $\qquad h(t) = (e^{-4t} - e^{-5t})u(t)$

$$y_{zs}(t) = (h * x)(t)$$

using Table 2.1 row 9.

$$= \frac{e^{-4t} - e^{-t} + 3te^{-t}}{9}u(t) + \frac{e^{-5t} - e^{-t} + 4te^{-t}}{16}u(t)$$

Simplifying we get

$$\boxed{y_{zs}(t) = \left(\frac{-7}{144}e^{-t} + \frac{1}{12}te^{-t} + \frac{1}{9}e^{-4t} - \frac{1}{16}e^{-5t}\right)u(t)}$$

9, d) To determine BIBO stability.

$$\int_{-\infty}^{\infty}|h(t)|\,dt < \int_{-\infty}^{\infty}(h(t))^2\,dt < \infty$$

$$\int_{-\infty}^{\infty}(h(t))^2\,dt = \int_0^{\infty}(e^{-4t} - e^{-5t})^2\,dt$$

$$= \int_0^{\infty}e^{-8t}\,dt - 2\int_0^{\infty}e^{-9t}\,dt + \int_0^{\infty}e^{-10t}\,dt$$

$$= -\frac{1}{8}e^{-8t}\Big|_0^{\infty} + \frac{2}{9}e^{-9t}\Big|_0^{\infty} + \frac{-1}{10}e^{-10t}\Big|_0^{\infty}$$

$$= \frac{1}{8} - \frac{2}{9} + \frac{1}{10} = \frac{1}{360} < \infty.$$

$\therefore$ BIBO Stable.

9, e) To determine Lyapunov stability

both roots of $Q(D)$ $-4, -5$ are in LHP

Thus the system is internal/(asymptotic)/zero-input/Lyapunov stable

(10) $y'' + 2y' + 10y = x' + 3x \quad y(0^-) = -1 \quad y'(0^-) = 1$

$Q(D) = D^2 + 2D + 10 \quad a_1 = 2 \quad a_2 = 10$

$P(D) = 0D^2 + D + 3 \quad b_0 = 0 \quad b_1 = 1 \quad b_2 = 3$

a) $Q(D)$ has 2 roots @ $-1 \pm j3$

$y_0(t) = e^{-t}(c_1 \cos(3t) + c_2 \sin(3t))$

$y_0'(t) = e^{-t}(-3c_1 \sin(3t) + 3c_2 \cos(3t))$

$\quad -e^{-t}(c_1 \cos(3t) + c_2 \sin(3t))$

$y_0(0^-) = c_1 = -1 \quad y'(0^-) = 3c_2 - c_1 = 1 \Rightarrow c_2 = 0$

$$\boxed{y_0(t)u(t) = -e^{-t}\cos(3t)u(t)}$$

b) $y_n(t) = e^{-t}(c_1 \cos(3t) + c_2 \sin(3t))$

using y_n' from a and I.C. $y_n(0^+) = 0 \quad y_n'(0^+) = 1$

$y_n'(0^+) = 3c_2 - c_1 = 1 \quad y_n(0^+) = c_1 = 0 \Rightarrow c_2 = \frac{1}{3}$

$y_n(t) = \frac{1}{3} e^{-t} \sin(3t)$

$h(t) = \underbrace{b_0}_{=0} \delta(t) + [P(D) y_n] u(t)$

$Dy_n = e^{-t}\cos(3t) - \frac{1}{3} e^{-t} \sin(3t)$

$3y_n = e^{-t} \sin(3t)$

Thus

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

10.c) $x(t) = e^{-2t}u(t)$ $\quad h(t) = h_1(t) + h_2(t)$

$$y_{zs}(t) = (h * x)(t) \qquad h_1(t) = e^{-t}\cos(3t)u(t)$$

$$h_2(t) = \frac{2}{3}e^{-t}\sin(3t)u(t)$$

$$= (h_1 * x)(t) + (h_2 * x)(t)$$

• $(h_1 * x)$ is Row 12 of Table 2.1 with
$\alpha = 1$ $\beta = 3$ $\theta = 0$ $\lambda = -2$ $\phi = \tan^{-1}\left(\frac{-3}{-1}\right)$

and $\cos(\theta - \phi) = -\frac{1}{\sqrt{10}}$

$$h_1 * x = \frac{-\frac{1}{\sqrt{10}}e^{-2t} - e^{-t}\cos\left(3t - \frac{3\pi}{4}\right)}{\sqrt{10}}$$

• $(h_2 * x)$ is also Row 12 with
$\alpha = 1$ $\beta = 3$ $\theta = -\frac{\pi}{2}$ $\lambda = -2$ $\phi = \tan^{-1}\left(\frac{-3}{-1}\right)$

and $\cos(\theta - \phi) = \frac{3}{\sqrt{10}}$

$$h_2 * x = \frac{\frac{3}{\sqrt{10}}e^{-2t} - e^{-t}\sin\left(3t - \frac{3\pi}{4}\right)}{\sqrt{10}}$$

Putting these back together and simplifying gives:

$$\boxed{y_{zs}(t) = \left[\frac{1}{10}e^{-2t} - \frac{1}{10}e^{-t}\cos(3t) + \frac{11}{30}e^{-t}\sin(3t)\right]u(t)}$$

10.d) $h(t) \le \frac{5}{3}e^{-t}$ $\forall t \ge 0$ thus.

$$\int_0^\infty \frac{5}{3}e^{-t}\,dt = \frac{5}{3}\left(-e^{-t}\right)\Big|_0^\infty = 0 + \frac{5}{3} = \frac{5}{3} < \infty$$

$\therefore$ BIBO stable

10.e) Roots of $Q(D)$: $-1 \pm j3$

Real part, $-1 < 0$ so in LHP $\therefore$ Lyapunov Stable

(11) $y' + 2y = 3x' + 6x$

$Q(D) = D + 2 \quad a_1 = 2 \qquad P(D) = 3D + 6 \quad b_0 = 3$
$b_1 = 6$

a) $y_n(t) = Ce^{-2t}$ $\Rightarrow$ $y_n(t) = e^{-2t}$

$y_n(0^+) = C = 1$ $\qquad Dy_n = -2e^{-2t}$

$$h(t) = \underset{3}{\underset{\shortparallel}{b_0}}\, \delta(t) + [P(D)\, y_n]\, u(t)$$

$$= 3\,\delta(t) + [3Dy_n + 6y_n]\, u(t)$$

$$= 3\,\delta(t) + [\underbrace{-6e^{-2t} + 6e^{-2t}}_{0}]\, u(t)$$

$$\boxed{h(t) = 3\,\delta(t)}$$

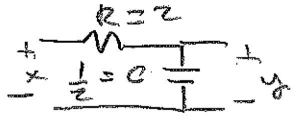
b) $h(t) = 3\delta(t) \qquad x(t) = u(t)$

$y_{zs}(t) = \underline{3u(t)}$ by δ property.

c) $\displaystyle\int_{-\infty}^{\infty} |3\delta(t)|\, dt = 3$ by sifting property $< \infty$ $\therefore$ <u>BIBO Stable</u>

d) root of $Q(D)$ is -2, is in LHP $\therefore$ <u>Lyapunov Stable</u>

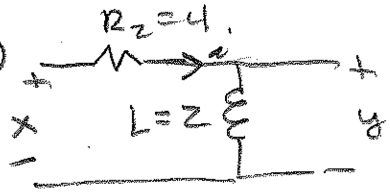
(12) a)



$$\frac{x-y}{R} = Cy' \quad \text{or} \quad y' + y = x$$

$$\underline{h(t) = e^{-t}u(t)}$$

b)



$x = 4i + y$ KVL

$y = 2i'$

$x' = 4i' + y'$ or $y' + 2y = x'$, $b_0 = 1$

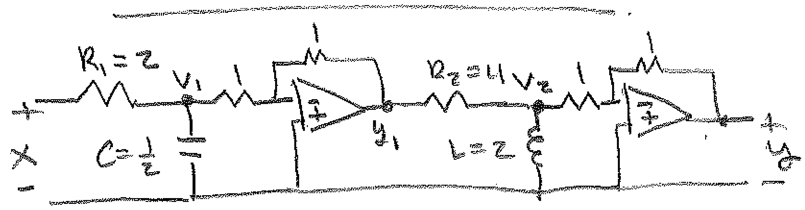
$y_n = C_1 e^{-2t}$

$y_n(0^+) = C = 1$

$$h(t) = \delta(t) + [P(D)y_n]u(t)$$

$$\underline{h(t) = \delta(t) - 2e^{-2t}u(t)}$$

c)



- $\frac{X-V}{R_1} = CV_1' + V_1$ AND $y_1 = -V_1$ gives
  $x = -R_1 C y_1' - (1+R_1)y_1$
- $\frac{y_1 - V_2}{R_2} = i_L + V_2$ with $V_2 = L i_L'$ and $y = -V_2$
  gives $y_1' = -\frac{R_2}{L}y - (1+R_2)y'$
- Substitution and using component values gives.

$$y'' + \frac{17}{5}y' + \frac{6}{5}y = \frac{1}{5}x'$$

$Q(D) = D^2 + \frac{17}{5}D + 6/5$ $\qquad P(D) = \frac{1}{5}D$

roots $-3, -2/5$

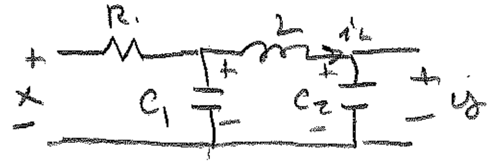
$y_n(t) = C_1 e^{-3t} + C_2 e^{-2/5 t}$ $\qquad y_n(0^+) = C_1 + C_2 = 0$

$y_n'(t) = -3C_1 e^{-3t} - \frac{2}{5}C_2 e^{-2/5 t}$ $\qquad y_n'(0^+) = -3C_1 - \frac{2}{5}C_2 = 1$

$C_1 = -\frac{5}{13}$ $\quad C_2 = \frac{5}{13}$

$$h(t) = \frac{1}{5}Dy_n u(t) = \underline{\left(\frac{3}{13}e^{-3t} - \frac{2}{65}e^{-2/5 t}\right)u(t)}$$

(13)



a) 3 states: V_{c_1}, i_L, V_{c_2}

KCL: $\frac{x - V_{c_1}}{R} = C_1 V_{c_1}' + i_L$ rearranging gives

$$V_{c_1}' = -\frac{1}{RC_1} V_{c_1} - \frac{1}{C_1} i_L + \frac{1}{RC_1} x \quad (1)$$

KVL: $V_{c_1} = L i_L' + V_{c_2}$ gives

$$i_L' = \frac{1}{L} V_{c_1} + \frac{1}{L} V_{c_2} \quad (2)$$

KCL: $i_L = C_2 V_{c_2}'$ or $V_{c_2}' = \frac{1}{C_2} i_L \quad (3)$

combining (1)(2)(3) in Matrix Form gives.

$$\begin{bmatrix} V_{c_1}' \\ i_L' \\ V_{c_2}' \end{bmatrix} = \begin{bmatrix} -\frac{1}{RC_1} & -\frac{1}{C_1} & 0 \\ 1/L & 0 & -1/L \\ 0 & 1/C_2 & 0 \end{bmatrix} \begin{bmatrix} V_{c_1} \\ i_L \\ V_{c_2} \end{bmatrix} + \begin{bmatrix} 1/RC_1 \\ 0 \\ 0 \end{bmatrix} x$$

with $y = V_{c_2}$

b) Let $V_{c_2} = y$ then (2) becomes

$$i_L' = \frac{1}{L} V_{c_1} - \frac{1}{L} y$$ substitute.

AND (3) becomes $y' = \frac{1}{C_2} i_L$ or $y'' = \frac{1}{C_2} i_L'$

give $y'' = \frac{1}{LC_2} V_{c_1} - \frac{1}{LC_2} y \Rightarrow V_{c_1} = LC_2 y'' + y \quad (4)$

and $V_{c_1}' = LC_2 y''' + y' \quad (5)$

Now using (1)

$$\overset{(5)}{V_c'} = -\frac{1}{RC_1} \overset{(4)}{V_{c_1}} - \frac{1}{C_1} \overset{C_2 y'}{i_L} + \frac{1}{RC_1} x$$

Substituting and rearranging gives:

$$y''' + \frac{1}{RC_1} y'' + \frac{\left(1 + \frac{C_2}{C_1}\right)}{LC_2} y' + \frac{1}{RC_1 C_2 L} y = \frac{1}{RC_1 C_2 L} x$$

13e.) $R=10 \quad C_1 = 1\mu F \quad C_2 = 2.2\mu F \quad L = 1mH$

substituting

$$y''' + 10^5 y'' + 1.45\times10^9 y' + 4.545\times10^{13} y$$

$Q(D)$ has 3 roots $\lambda_1 = -89418$

$\lambda_{2,3} = -5290 \pm j\,21916$ using software

$= \sigma \pm j\omega$

Thus $y_n(t) = C_1 e^{\lambda_1 t} + e^{\sigma t}(C_2 \cos(\omega t) + C_3 \sin(\omega t))$

$y_n'(t) = C_1 \lambda_1 e^{\lambda t} + \sigma e^{\sigma t}(C_2 \cos(\omega t) + C_3 \sin(\omega t))$

$+ e^{\sigma t}(-C_2 \omega \cos(\omega t) + C_3 \omega \cos(\omega t))$

AND

3 Eqn, 3 unknown:

$$\left\{\begin{aligned} y_n(0^+) &= C_1 + C_2 = 0 \\ y_n'(0^+) &= C_1\lambda_1 + C_2\sigma + C_3\omega = 0 \\ y_n''(0^+) &= C_1\lambda_1^2 + C_2\sigma^2 + C_3\sigma\omega - C_2\omega^2 = 1 \end{aligned}\right.$$

Solving for constants using software.

$$C_1 = \frac{-1}{-\lambda_1^2 + 2\lambda_1\sigma - \sigma^2 - \omega^2}$$

$$C_2 = \frac{1}{-\lambda_1^2 + 2\lambda\sigma - \sigma^2 - \omega^2}$$

$$C_3 = \frac{-(\lambda_1 - \sigma)}{\omega(\lambda^2 + 2\lambda\sigma + \omega^2)}$$

$$h(t) = \underbrace{b_0}_{0}\delta(t) + [\underbrace{P(D)}_{\frac{1}{RC_1C_2L} \equiv \zeta} y_n]u(t)$$

$$\boxed{\text{then } h(t) = \left[\zeta C_1 e^{\lambda_1 t} + e^{\sigma t}(\zeta C_2 \cos(\omega t) + \zeta C_3 \sin(\omega t))\right]u(t)}$$

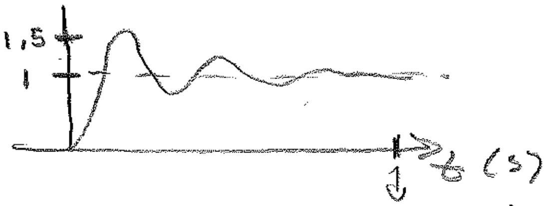
Where $\zeta C_1 \approx 6000 \qquad \lambda_1 = -89418$

$\zeta C_2 \approx -6000 \qquad \sigma = -5290 \quad \omega = 21916$

$\zeta C_3 \approx 25000$

14 a) A plot of $\int_0^t h(\tau)\,d\tau$ looks like:

So the steady-state output is ≈ 1



b) The system time constant is $\approx$ → 0,001 = 1 ms