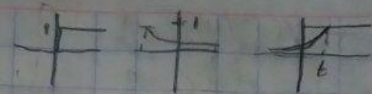
Ornelas Garcia Luis Angel

Problemario 2º parcial Sección 1

1

a) $u(t) * e^{-t}u(t)$



$\int_0^t e^{\tau-t}\,d\tau$

b) $u(t) * tu(t)$

$\int_0^t (t-\tau)\,d\tau = t\tau - \frac{\tau^2}{2}\Big|_0^t = t^2 - \frac{t^2}{2} = \frac{t^2}{2}$

c) $e^{-t}u(t) * e^{-3t}u(t)$

$\int_0^t e^{3(t-\tau)}\cdot e^{\tau} = \int_0^t e^{3t-2\tau}\,d\tau$

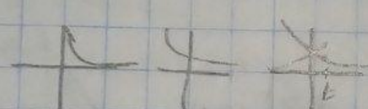
d) $u(t) * u(t)$

$\int_0^t d\tau = t-0 = t$

e) $e^{-t}u(t) * tu(t)$

$\int_0^t e^{-\tau}\cdot(t-\tau)\,d\tau$

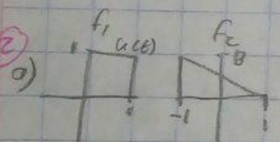
f) $e^{-3t}u(t) * e^{-t}$



$\int_{-\infty}^{\infty} e^{-3(t-\tau)}e^{-\tau}\,d\tau$

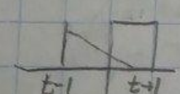
2

a)



$-\frac{B}{2}(\tau-1)$

$-\frac{B}{2}\int_0 (t-1-\tau)\,d\tau$



$-\frac{B}{2}\int_0^{t+1}(t-1-\tau)\,d\tau$

$-\frac{B}{2}\int_{t-1}^{1}(t-1-\tau)\,d\tau$

$f_1 * f_2 = -\frac{B}{2}\left[\int_0^{t+1}(t-1-\tau)\,d\tau + \int_0^1 (t-1-\tau)\,d\tau + \int_{t-1}^1 (t-1-\tau)\,d\tau\right]$

b)

$f_1 * f_2 = \int_1^{t-0.5} AB\,d\tau + \int_{t-1}^{t-.5} AB\,d\tau + \int_{t-1}^{2} AB\,d\tau$

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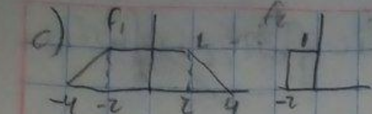
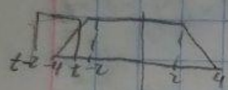
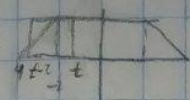
c)



$$f_1 = \begin{cases} \frac{1}{2}(\tau+4) \\ 1 \\ -\frac{1}{2}(\tau-4) \end{cases}$$

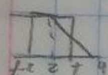


$$-\frac{1}{2}\int_{-4}^{t}(\tau-4)\,d\tau$$



$$-\frac{1}{2}\int_{t-2}^{-2}(\tau-4)\,d\tau + \int_{-2}^{t} d\tau$$

$$\int_{t-2}^{t} d\tau$$



$$\int_{t-2}^{2} d\tau + \frac{1}{2}\int_{2}^{t}(\tau+4)\,d\tau$$

$$\frac{1}{2}\int_{t-2}^{4}(\tau+4)\,d\tau$$

$$f_1 * f_2 = -\frac{1}{2}\int_{-4}^{t}(\tau-4)\,d\tau - \frac{1}{2}\int_{t-2}^{-2}(\tau-4)\,d\tau + \int_{-2}^{t} d\tau + \int_{t-2}^{t} d\tau + \int_{t-2}^{2} d\tau + \frac{1}{2}\int_{2}^{t}(\tau+4)\,d\tau + \frac{1}{2}\int_{t-2}^{4}(\tau+4)\,d\tau$$

3

$f_1 * f_2$

$$f_1 * f_2 = \int_{0}^{t+1} d\tau + \int_{t}^{1} d\tau - \int_{1}^{t+1} d\tau - \int_{t}^{2} d\tau$$

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$f_1 * f_3$

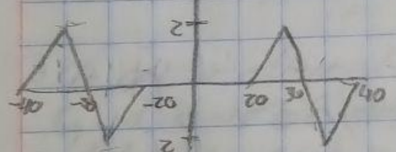
$$f_1 * f_3 = \int_{-1}^{t+1}(\tau+1) + \int_{t}^{0}(\tau+1) + \int_{0}^{t+1}(-\tau+1) + \int_{t}^{1}(-\tau+1)$$

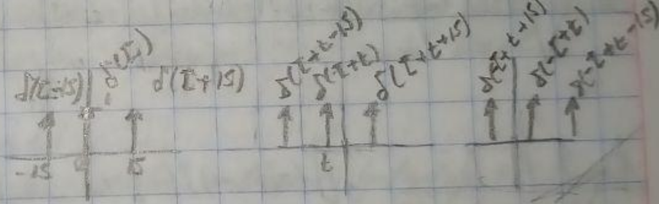
$f_2 * f_3$

$$f_2 * f_3 = \int_{0}^{t+1}(-\tau+1) + \int_{0}^{t}(\tau+1) + \int_{t}^{1}(-\tau+1) + \int_{1}^{t+1}-(-\tau+1) + \int_{0}^{1}(\tau+1) + \int_{1}^{2}-(-\tau+1) + \int_{t-1}^{1}(\tau+1) + \int_{1}^{t}-(\tau+1)$$

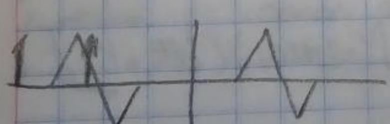
$$+ \int_{t}^{2}-(-\tau+1) + \int_{t-1}^{2}-(\tau+1)$$

4





$$\frac{2}{3}\int_{(t-15)^-}^{(t-15)^+}(\tau+40)\,\delta(\tau+t-15)$$



$$\frac{2}{3}\int(\tau+30)\,\delta(-\tau+t-15)$$

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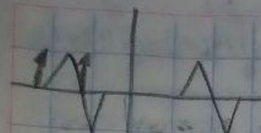
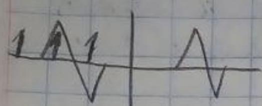


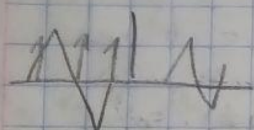
$$\frac{2}{5}\left[\int \delta(\tau+30)\,\delta(-\tau+t+15) + \int(\tau+40)\,\delta(-\tau+t)\right]$$

$$\frac{2}{5}\left[\int \delta(-\tau+30)\,\delta(-\tau+t+15) + \int(-\tau+30)\,\delta(-\tau+t)\right]$$

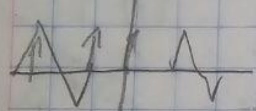


$$\frac{2}{5}\left[\int \delta(-\tau+30)\,\delta(-\tau+t+15) + \int(-\tau+30)\,\delta(-\tau+t)\right]$$

$$\frac{2}{5}\left[\int(-\tau+30)\,\delta(-\tau+t+15) + \int(-\tau+30)\,\delta(-\tau+t) + \int(+\tau-30)\,\delta(t)\right]$$



$$\frac{2}{5}\left[\int(-\tau+30)(-\tau+t+15) + \int(-\tau+30)\,\delta(-\tau+t) + \int(+\tau+20)\,\delta(-\tau+t-15)\right]$$



$$\frac{2}{5}\left[\int(-\tau+20)\,\delta(-\tau+t+15) + \int(-\tau+20)\,\delta(-\tau-t-15)\right]$$

$$\frac{2}{5}\left[\int(-\tau+20)\,\delta(\tau+t-15)\right]$$

$$\frac{2}{5}\left[\int(-\tau+20)\,\delta(-\tau+t+15) + \int(-\tau+20)\,\delta(\tau+t+15)\right]$$

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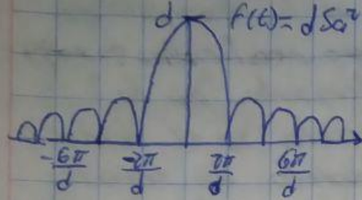
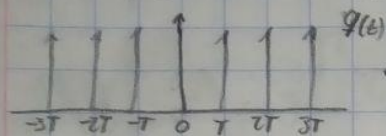
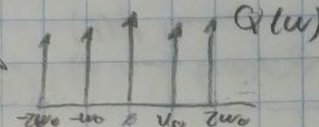
4. Considere la sig función en el tiempo $f(t)$ y su transformación $F(\omega)$. Desarrolle gráfica y matemáticamente el muestreo ideal



Si $f(t) \rightarrow F(\omega)$ y $g(t) \rightarrow Q(\omega)$



$\longleftrightarrow$



$\longleftrightarrow$

$$d\,Sa^2\left(\frac{dt}{2}\right) \longleftrightarrow 2\pi\,\Lambda\left(\frac{\omega}{d}\right)$$

$$\sum_{n=-\infty}^{\infty} \delta(t-nT) \longleftrightarrow \omega_0 \sum_{n=-\infty}^{\infty} \delta(\omega - n\omega_0)$$

$$\sum_{n=-\infty}^{\infty} f(nT)\,\delta(t-nT) \longleftrightarrow \frac{1}{T} \sum_{n=-\infty}^{\infty} F(\omega - n\omega_0)$$

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5. Determine la rapidez mínima de muestreo y el intervalo de Nyquist de las sig. señales:

a) $Sa(100t)$

$$A\,C_d(t) \longrightarrow A d\, Sa\left(\frac{wd}{2}\right)$$
$$C_d(t) \longleftrightarrow d\, Sa\left(\frac{wd}{2}\right)$$
$$d\, Sa\left(\frac{td}{2}\right) \longleftrightarrow 2\pi C_d(w)$$
$$200\, Sa(100t) \longleftrightarrow 2\pi C_{200}(w)$$

La componente frec. $W_0 = 200 \frac{rad}{s}$

así $f_m = \frac{200}{2\pi} = 100/\pi$ Hz

$$2f_m = \frac{200}{\pi}$$

$$T_W = \frac{1}{2f_m} = \frac{\pi}{200} s$$

b) $Sa^2(100t)$

$$\Lambda\left(\frac{t}{a}\right) \longrightarrow d\, Sa^2\left(\frac{wd}{2}\right)$$
$$d\, Sa^2\left(\frac{td}{2}\right) \longleftrightarrow 2\pi \Lambda(w/a)$$
$$200\, Sa^2(100t) \longleftrightarrow 2\pi \Lambda(w/a)$$
$$Sa^2(100t) \longleftrightarrow \frac{\pi}{100} \Lambda(w/a)$$

$W_0 = 200 \frac{rad}{s}$ $\quad f_m = \frac{200}{2\pi} = \frac{100}{\pi}$ Hz

$$T_W = \frac{1}{2f_m} = \frac{\pi}{200} s$$

c) $Sa(100t) + Sa(50t)$

$$A C_d(t) \longleftrightarrow A d\, Sa\left(\frac{wd}{2}\right)$$
$$C_d(t) \longleftrightarrow d\, Sa\left(\frac{wd}{2}\right)$$
$$d\, Sa\left(\frac{td}{2}\right) \longrightarrow 2\pi C_d(w)$$
$$200\, Sa(100t) \longleftrightarrow 2\pi C_{200}(w)$$
$$Sa(100t) \longleftrightarrow \frac{\pi}{100} C_{200}(w)$$

$$A C_d(t) \longleftarrow A d\, Sa\left(\frac{wd}{2}\right)$$
$$C_d(t) \longrightarrow d\, Sa(wd/2)$$
$$d\, Sa\left(\frac{td}{2}\right) \longrightarrow C_d(w) \cdot 2\pi$$
$$100\, Sa(50t) \longrightarrow C_{100}(w) \cdot 2\pi$$
$$Sa(50t) \longrightarrow \frac{\pi}{50} C_{100}(w)$$

$$Sa(100t) + Sa(50t) \longleftrightarrow \frac{\pi}{50}\left[\frac{1}{2} C_{200}(w) + C_{100}(w)\right]$$

La componente frec más grande es $W_m = 200 \frac{rad}{s}$

$$f_m = \frac{200}{2\pi} = \frac{100}{\pi} Hz$$

$$T_W = \frac{1}{2f_m} = \frac{\pi}{200} s$$

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6. Se sabe que una señal de valor real $x(t)$ ha sido determinada solo por sus muestras cuando la frecuencia de muestreo es $w_s = 10{,}000\pi t$ ¿Para que valores de w se garantiza que $F(w)$ sea cero?

Sea $W_s = 10{,}000\pi t \ldots$ (1)

Dividiendo entre 2π a (1) obtenemos $W_s = 5000\,t$ $\therefore$

Se garantiza que $F(w)$ sea cero para valores de $5000t$

7. Aquella frecuencia de acuerdo con el teorema de muestreo, debe ser excedida por la frecuencia de muestreo se llama razón de Nyquist; Determine la razón Nyquist correspondiente correspondiente a cada una de las sig. señales:

a) $x(t) = 10\,\text{sen}(wt) + 5\,\text{sen}(wt)$

$10\,\text{sen}\,wt \leftrightarrow ?$

$10\,\text{sen}\,wt \leftrightarrow 10\pi i\,[\delta(w-W) - \delta(w-W)]$

$5\,\text{sen}(wt) \leftrightarrow ?$

$5\,\text{sen}(wt) \leftrightarrow 5\pi i\,[\delta(w+W) - \delta(w-W)]$

La componente frec. es $W_m = W$

así $f_m = \frac{W}{2\pi}$

$T = \frac{1}{2f_m} = \frac{2\pi}{2W} = \frac{\pi}{W}$ Hz

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b) $x(t) = 1+\cos(2000\pi t)+\text{sen}(4000\pi t)$

$\delta(t) \longleftrightarrow 1$

$1 \longleftrightarrow 2\pi\delta(w)$

$\cos(2000\pi t) \longleftrightarrow \pi[\delta(w+2000\pi)+\delta(w-2000\pi)]$

$\text{sen}(4000\pi t) \longleftrightarrow \pi i[\delta(w+4000\pi)-\delta(w-4000\pi)]$

$x(t) \longleftrightarrow 2\pi\delta(w)+\pi[\delta(w+2000\pi)+\delta(w-2000\pi)]+\pi i[\delta(w+4000\pi)-\delta(w-4000\pi)]$

$w_m = 4000\pi \qquad f_m = \frac{4000\pi}{2\pi} = 2000 \qquad T = \frac{1}{2f_m} = \frac{1}{4000}\ Hz$

8. Una señal continua $x(t)$ se obtiene a la salida de un filtro paso bajo ideal con frec. de corte $w_c = 1000\pi$. Si el muestreo garantiza que $x(t)$ se pueda recuperar a partir de sus versiones muestreadas usando un filtro paso bajo adecuado?

a) $T = 0.5\times10^{-3}$

b) $T = 2\times10^{-3}$

c) $T = 10^{-4}$

$W_c = 1000\pi \Rightarrow f_m = \frac{1000\pi}{2\pi} = 500\ Hz$

$T = \frac{1}{2f_m} = \frac{1}{1000} = 10^{-3}\ s$

a) $0.5\times10^{-3} \leq 10^{-3}\ s$ si cumple

b) $2\times10^{-3} \geq 10^{-3}\ s$ no cumple

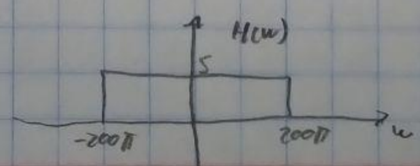
c) $10^{-4} \leq 10^{-3}\ s$ si cumple

9. Dibuje la función de transferencia $H(w)$ de un filtro pasabajas con ganancia 5 y frec. de corte 100 Hz

$f_m = 100\ Hz$

$w_m = 200\pi\ \frac{rad}{s}$

$H(w) = T\, C_{2w_m}(w) = 5\, C_{400\pi}(w)$



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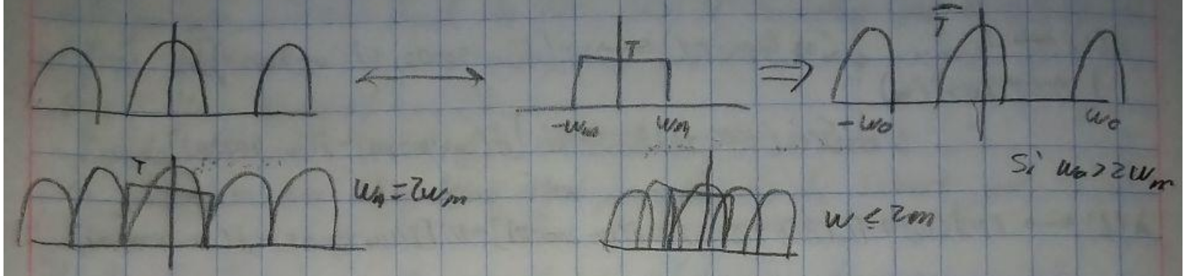
10. Dibuje la funcion caracteristica $h(t)$ del filtro anterior



11. Considera el sistema mostrado en la figura siguiente. La señal de entrada al sistema es $x_a(t) = 3\cos 100\pi t + 2\,\text{sen}\, 250\pi t$
Determine la versión discreta de $x_a(t)$ ¿Es posible recuperar la señal original a partir de $x(n)$ usando un filtro pasabajas adecuado?

$$x_a(t) \longrightarrow \boxed{\begin{matrix} A/D \\ T = 5ms \end{matrix}} \longrightarrow x(n)$$

Si $f_m = \frac{100\pi}{2\pi} = 50 \longrightarrow 2f_m = 100\,Hz$ ∴ Si es posible recuperarla

$T_n = \frac{1}{2f_m} = \frac{1}{100} sg \longrightarrow f_n = 2f_m = 100\,Hz$

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12. Analice las sig. sec. (esto es su frec. digital) e indique si son o no periodicas. En caso de ser periodicas, halle su periodo

a) $x(n) = \cos\left(\frac{2\pi n}{3}\right) + e^{\pi n}$

$x_a(n) = \cos\left(\frac{2\pi n}{3}\right)$; es periodica $T = 3$ $\therefore$ $x(n)$ no es periodica

$x_b(n) = e^{\pi n}$; no es periodica

b) $y(n) = 2 + Re\left[e^{\frac{in\pi}{3}}\right] + \cos\left(\frac{3\pi n}{2}\right)$

$y_1(n) = 2 = \{\ldots, 2, 2, 2, 2, \ldots\}$

$y_2(n) = Re\{e^{\frac{in\pi}{3}}\} = \cos\frac{n\pi}{3} = \{\ldots, 1, \frac{1}{2}, \frac{1}{2}, -1, 1/2, 1/2, \underline{1, 1/2, 1/2, -1, 1/2, 1/2} \ldots\}$

$N = 6$

$y_3(n) = \cos\left(\frac{3n\pi}{2}\right) = \{\ldots, -1, 0, 1, 0, -1, 0, 1, 0, -1, \ldots\}$

$N = 1$

$\therefore N = \underline{12}$

13. Grafique la sig. señal $x(n)$ que es una suma de sinusoides, indique su periodo. ¿Cual es el periodo de la suma de dos sinusoides de periodo N_1 y N_2?

$x(n) = \underbrace{10 \operatorname{sen}\left(\tfrac{3}{2}\pi n\right)}_{N_1} + \underbrace{5\cos\left(\tfrac{4}{9}\pi n\right)}_{N_2}$

$N_1 = 4$

$N_2 = 18$

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Seccion 3

1. Considere las sig. sec. y realice con ellas las operaciones indicadas

$x(n) = \{\bar{0}, 1, 2, 3, 4, 5, 6, 7, 8\}$

$y(n) = \{\bar{2}, 4, 8, 16, 32\}$

$z(n) = \sum_{n=-3}^{3} \delta(n-k)$

$g(n) = \{\frac{1}{3}, \frac{1}{6}, \frac{1}{9}, \bar{\frac{1}{12}}, \frac{1}{15}, \frac{1}{18}, \ldots\}$

$k(n) = 2u(n-2)$

encuentre:

a) $g(-n) = \{\ldots, \frac{1}{18}, \frac{1}{15}, \bar{\frac{1}{12}}, \frac{1}{9}, \frac{1}{6}, \frac{1}{3}\}$

b) $z(n) + y(n) = \{1, 1, 1, 1, 2, 3, 4, 4, 5, 6, 7, 8\}$

c) $3g(n) - 6z(n)$

$3g(n) = \{1, 1/2, 1/3, 1/4, 1/5, 1/6, \ldots\}$

$-6z(n) = \{-6, -6, -6, -6, -6, -6\}$

$3g(n) - 6z(n) = \{-5, -11/2, -17/3, -\frac{23}{4}, -29/5, -35/6, \ldots\}$

d) $y(n-6) = \{\bar{0}, 0, 2, 4, 8, 16, 32\}$

e) $\frac{1}{2}y(n-3) = \{1, 2, 4, 8, 16, 0, 0, \bar{0}\}$

f) $x(n-2) = \{\bar{0}, 0, 0, 1, 2, 3, 4, 5, 6, 7, 8\}$

g) $x(3n-3)$

$x(n-3) = \{\bar{0}, 0, 0, 0, 1, 2, 3, 4, 5, 6, 7, 8\}$

$x(3n-3) = \{\bar{0}, 0, 3, 6\}$

h) $x(\frac{n}{2}+5)$

$x(n+5) = \{0, 1, 2, 3, 4, \bar{5}, 6, 7, 8\}$

$x(\frac{n}{2}+5) = \{0, 0, 1, 1, 2, 2, 3, 3, 4, 4, 5, 5, 6, 6, 7, 7, 8, 8\}$

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i) $y\left(\frac{n-3}{3}\right)$

$y(n-3)=\{2,\bar{4},8,16,32\}$

$y\left(\frac{n-3}{3}\right)=\{2,2,2,4,4,4,8,8,8,16,16,16,32,32,32\}$

j) $k\left(\frac{4n-3}{10}\right)$

$k(n)=\{\bar{0},0,2,2,2\ldots\}$

$k(n-3)=\{\bar{0},0,0,0,0,2,2,2,\ldots\}$

$k\left(\frac{n-3}{10}\right)=\{0000000000,0000000000,0000000000,0000000000,$
$0000000000,2222222222,2222222222,\ldots\}$

$k\left(\frac{4n-3}{10}\right)=\{0,0,0,0,0,0,0,0,0,0,0,0,0,2,2,2,2,2,2,\ldots\}$

k) $k\left(-\frac{n}{4}+10\right)$

$k(n)=\{\bar{0},0,2,2,2,2\ldots\}$

$k(-n)=\{\ldots,2,2,2,2,0,\bar{0}\}$

$k(-n/4)=\{\ldots2,\bar{0}\}$

$k(-n/4+10)=\{\ldots,2,0,0,0,0,0,0,0,0,0,0,\bar{0}\}$

l) $x\left(\frac{3n-3}{3}\right)-g\left(-\frac{8n-7}{3}\right)$

$x(3n)=\{\bar{0},3,6\}$

$x(3n-3)=\{\bar{0},0,0,0,3,6\}$

$x\left(\frac{3n-3}{3}\right)=\{0,0,0,0,0,0,0,0,0,0,0,0,3,3,3,3,6,6,6,6\}$

$g(8n)=\{1/3,1/3,1/3,1/3,1/3,1/3,1/3,1/3,1/3,1/6,1/6,1/6,1/6,1/6,1/6,1/6,1/6,1/6,\ldots\}$

$g(-8n-7)=\{1/15,1/15,1/15,1/15,1/15,1/15,1/15,1/15,1/15,1/12,1/12,1/12,1/12,1/12,1/12,1/12,1/12,1/12,$
$1/9,1/9,1/9,1/9,1/9,1/9,1/9,1/9,1/9,1/6,1/6,1/6,1/6,1/6,1/6,1/6,1/6,1/6,1/3,1/3,1/3,$
$1/3,1/3,1/3,1/3,1/3,1/3\}$

$g\left(\frac{-8n-7}{3}\right)=\{1/15,1/15,1/15,1/12,1/12,1/12,1/9,1/9,1/9,1/6,1/6,1/6,1/3,1/3,1/3\}$

$x\left(\frac{3n-3}{3}\right)-g\left(-\frac{8n-7}{3}\right)=\{\ldots,-\bar{1}/16,-1/9,2/3,2,3,4,5,6,7,8\}$

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i) $y\left(\frac{n-3}{3}\right)$

$y(n-3)=\{2,\bar{4},8,16,32\}$

$y\left(\frac{n-3}{3}\right)=\{2,2,2,4,4,4,8,8,8,16,16,16,32,32,32\}$

j) $k\left(\frac{4n-3}{10}\right)$

$h(n)=\{\bar{0},0,2,2,2\ldots\}$

$h(n-3)=\{\bar{0},0,0,0,0,2,2,2,\ldots\}$

$k\left(\frac{n-3}{10}\right)=\{0000000000,0000000000,0000000000,0000000000,0000000000,2222222222,2222222222,\ldots\}$

$k\left(\frac{4n-3}{10}\right)=\{0,0,0,0,0,0,0,0,0,0,0,0,0,2,2,2,2,2,2,\ldots\}$

k) $k\left(-\frac{n}{4}+10\right)$

$k(n)=\{\bar{0},0,2,2,2,2\ldots\}$

$k(-n)=\{\ldots,2,2,2,2,0,\bar{0}\}$

$k(-n/4)=\{\ldots 2,\bar{0}\}$

$k(-n/4+10)=\{\ldots,2,0,0,0,0,0,0,0,0,0,0,\bar{0}\}$

l) $x\left(\frac{3n-3}{3}\right)-g\left(-\frac{8n-7}{3}\right)$

$x(3n)=\{\bar{0},3,6\}$

$x(3n-3)=\{\bar{0},0,0,0,3,6\}$

$x\left(\frac{3n-3}{3}\right)=\{0,0,0,0,0,0,0,0,0,0,0,0,3,3,3,3,6,6,6,6\}$

$g(8n)=\{\frac{1}{3},\frac{1}{3},\frac{1}{3},\frac{1}{3},\frac{1}{3},\frac{1}{3},\frac{1}{3},\frac{1}{3},\frac{1}{3},\frac{1}{6},\frac{1}{6},\frac{1}{6},\frac{1}{6},\frac{1}{6},\frac{1}{6},\frac{1}{6},\frac{1}{6},\frac{1}{6},\ldots\}$

$g(-8n-7)=\{\frac{1}{15},\frac{1}{15},\frac{1}{15},\frac{1}{15},\frac{1}{15},\frac{1}{15},\frac{1}{15},\frac{1}{15},\frac{1}{15},\frac{1}{12},\frac{1}{12},\frac{1}{12},\frac{1}{12},\frac{1}{12},\frac{1}{12},\frac{1}{12},\frac{1}{12},\frac{1}{12},$
$\frac{1}{9},\frac{1}{9},\frac{1}{9},\frac{1}{9},\frac{1}{9},\frac{1}{9},\frac{1}{9},\frac{1}{9},\frac{1}{9},\frac{1}{6},\frac{1}{6},\frac{1}{6},\frac{1}{6},\frac{1}{6},\frac{1}{6},\frac{1}{6},\frac{1}{6},\frac{1}{6},\frac{1}{3},\frac{1}{3},\frac{1}{3},$
$\frac{1}{3},\frac{1}{3},\frac{1}{3},\frac{1}{3},\frac{1}{3},\frac{1}{3}\}$

$g\left(\frac{-8n-7}{3}\right)=\{\frac{1}{15},\frac{1}{15},\frac{1}{15},\frac{1}{12},\frac{1}{12},\frac{1}{12},\frac{1}{9},\frac{1}{9},\frac{1}{9},\frac{1}{6},\frac{1}{6},\frac{1}{6},\frac{1}{3},\frac{1}{3},\frac{1}{3}\}$

$x\left(\frac{3n-3}{3}\right)-g\left(\frac{-8n-7}{3}\right)=\{\ldots,-\bar{1}/16,-1/9,\frac{3}{3},2,3,4,5,6,7,8\}$

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m) $u(n) * g(n) + z(n)$

$u(n) = \{\bar{1}, 1, 1, \ldots\}$

$g(n) = \{\bar{1/3}, 1/6, 1/9, 1/12, 1/15, 1/18 \ldots\}$

$u(n) * g(n) = \{\bar{1/12}, 1/15, 1/18, 1/21, 1/24, \ldots\}$

$+ z(n) = \{1, 1, 1, 1, 1, 1, 1\}$

$u(n) * g(n) + z(n) = \{1, 1, \bar{13/12}, 16/15, 19/18 \ldots\}$

n) $x(n/2) * y(n/3)$

$x(n/2) = \{00\ 11\ 22\ 33\ 44\ 55\ 66\ 77\ 88\}$

$y(n/3) = \{2, 2, 2, 4, 4, 4, 8, 8, 8, 16, 16, 16, 32, 32, 32\}$

$x(n/2) * y(n/3) = \{0, 0, 2, 4, 8, 14, 22, 32, 48, 66, 90, \bar{124}, 164, 214$
$286, 302, 472, 558, 640, 790, 788, 832, 896, 936,$
$960, 960, 880, 896, 832, 766, 256$

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Sección 4 transformada Z

Encuentre la transformada Z y grafique la región de convergencia de x(n)

$x(n) = (1/4)^n u(n) + 2(1/2)^n u(-n-1)$

$Z\{x(n)\} = X(z) = \sum_{n=-\infty}^{\infty} [x_1(n) + x_2(n)] z^{-n}$

$X(z) = X_1(z) + X_2(z)$

$x_1(n) = \begin{cases} (1/4)^n & n \geq 0 \\ 0 & \text{otro caso} \end{cases}$

$X_1(z) = \sum_{n=0}^{\infty} (1/4)^n z^{-n} = \sum_{n=0}^{\infty} \left(\frac{1}{4z}\right)^n = \frac{1}{1 - \frac{1}{4z}}$

$= \frac{4z}{4z-1} = \frac{z}{z - \frac{1}{4}}, \ |z| > \frac{1}{4}$

$x_2(z) = \begin{cases} 2(\frac{1}{2})^n & \leq 1 \\ 0 & \text{otro caso} \end{cases}$

$X_2(z) = \sum_{n=-\infty}^{1} 2\left(\frac{1}{2}\right) z^{-n} = \sum_{n=-\infty}^{1} 2\left(\frac{1}{2z}\right)^n = \sum_{n=1}^{\infty} \frac{1}{2} (2z)^n = \frac{\frac{1}{2}(2z)}{1 - (\frac{1}{2}(2z))}$

$= \frac{2z}{2-2z} = \frac{z}{1-z}, \ |z| < 1$