2.5

a. $c[n] = x[-n+2] = \{2 \ \underset{\uparrow_0}{0} \ -3 \ -2 \ 1 \ 5 \ -4\} \quad -1 \le n \le 5$

b. $d[n] = y[-n-3] = \{-2 \ 7 \ 8 \ 0 \ -1 \ \underset{\uparrow_{-3}}{-3} \ 6\} \quad -8 \le n \le -2$

c. $e[n] = w[-n] = \{5 \ -2 \ 0 \ -1 \ 2 \ 2 \ 3\} \quad -8 \le n \le -2$

d. $u[n] = x[n] + y[n-2] = \{-4 \ 5 \ 1 \ \underset{\uparrow}{-2} \ 3 \ -3 \ 1 \ 0 \ 8 \ 7 \ -2\}$

2.6 a. $x[n] = \{-4 \ 5 \ 1 \ -2 \ -3 \ 0 \ 2\} \quad -3 \le n \le 3$

$$= -4\delta(n+3) + 5\delta(n+2) + \delta(n+1) - 2\delta(n) - 3\delta(n-1) + 2\delta(n-3)$$

2.15 a. $x[n] = A\alpha^n \quad |\alpha| < 1$

$\lim_{n \to -\infty} A\alpha^n = \infty$ not bounded

b. $y[n] = A\alpha^n \mu[n] \quad |\alpha| < 1$

$|y[n]| = |A\alpha^n \mu[n]| = |A||\alpha^n| \quad n \geq 0$

$\le |A|$

$y[n] = 0 \quad n < 0$ bounded

c. $h[n] = C\beta^n \mu[n] \quad |\beta| > 1$

$\lim_{n \to \infty} h[n] = \infty$ not bounded

d. $|g[n]| = |4\cos(\omega_a n)| \le 4 \ \forall n$ bounded

e. $v[n] = \left(1 - \frac{1}{n^2}\right) \mu[n-1]$

$v[n] = 0 \quad n \le 0$

$|v[n]| = \left|1 - \frac{1}{n^2}\right| \le |1| + \left|\frac{1}{n^2}\right| \quad n \geq 1$

< 2 bounded

2.10 a. $x_1[n] = \mu[n+2]$

$x_{ev}[n] = \frac{1}{2}(x[n] + x[-n]) = \frac{1}{2}(\mu[n+2] + \mu[-n+2])$

$x_{odd}[n] = \frac{1}{2}(x[n] - x[-n]) = \frac{1}{2}(\mu[n+2] - \mu[-n+2])$

2.11 $x_{ev}[n] = \frac{1}{2}(x[n] + x[-n])$

For a sequence to be even, $x_a[n] = x_a[-n]$.

$x_{ev}[n] = \frac{1}{2}(x[n] + x[-n]) = \frac{1}{2}(x[-n] + x[n]) = x_{ev}[-n]$

similar for odd part

2.7 a. $y[n] = h[0]\,x[n] + h[1]\,x[n-1] + h[2]\,x[n-2]$

b. $u[n] = h[0]\,x[n] + \beta_{11} h[0]\,x[n-1] + \beta_{21} h[0]\,x[n-2]$

$y[n] = u[n] + \beta_{12} u[n-1] + \beta_{22} u[n-2]$

c. $u_1[n] = x[n] + .4\,u_1[n-1]$

$u_2[n] = u_1[n-1] - .8\,u_2[n-1] - .5\,u_2[n-2]$

$y[n] = .6\,u_2[n] + .3\,u_2[n-1] + .2\,u_2[n-2]$

d. $u_1[n] = x[n] + .4\,u_1[n-1]$

$u_2[n] = x[n] - .8\,u_2[n-1] - .5\,u_2[n-2]$

$y[n] = .6\,u_1[n] + .3\,u_2[n-1] + .2\,u_2[n-2]$

Class Prob

1. $x(t) = 5\sin(3\pi t)$

a. $F_s = 5\,Hz$ $\quad \omega_0 = \frac{3\pi}{5}\ \frac{rad}{sam}$

b. $F_s = 10\,Hz$ $\quad \omega_0 = \frac{3\pi}{10}\ \frac{rad}{sam}$

2. $x(t) = A\cos(\Omega_0 t)$ $\quad F_s = 10\,Hz$

$\omega_0 = \frac{3\pi}{10}\ \frac{rad}{sam}$ $\qquad \omega_0 = \frac{\Omega_0}{F_s} \Rightarrow \Omega_0 = 3\pi\ \frac{rad}{sec}$, $\ F_0 = \frac{3}{2}\,Hz$

2-35

a. $y[n] = b_0 x[n] + b_1 x[n-1] + b_2 x[n-2] + a_1 y[n-1] + a_2 y[n-2]$

Let $y_1[n] = T\{x_1[n]\}$ $\quad y_2[n] = T\{x_2[n]\}$

$y_3[n] = T\{\alpha x_1[n] + \beta x_2[n]\}$

we must show that $y_3[n] = \alpha y_1[n] + \beta y_2[n]$.

$y_3[n] = b_0(\alpha x_1[n] + \beta x_2[n]) + b_1(\alpha x_1[n-1] + \beta x_2[n-1]) +$
$b_2(\alpha x_1[n-2] + \beta x_2[n-2]) + a_1 y_3[n-1] + a_2 y_3[n-2]$

$= \alpha(b_0 x_1[n] + b_1 x_1[n-1] + b_2 x_1[n-2])$
$+ \beta(b_0 x_2[n] + b_1 x_2[n-1] + b_2 x_2[n-2]) + a_1 y_3[n-1] + a_2 y_3[n-2]$

$= \alpha(y_1[n] - a_1 y_1[n-1] - a_2 y_1[n-2])$
$+ \beta(y_2[n] - a_1 y_2[n-1] - a_2 y_2[n-2]) + a_1 y_3[n-1] + a_2 y_3[n-2]$

So $y_3[n] = \alpha y_1[n] + \beta y_2[n]$ if we have a causal input and

$y_1[-1] = y_1[-2] = y_2[-1] = y_2[-2] = 0$.

2.36

a. $y[n] = n^3 x[n]$

1. $T\{\alpha x_1[n] + \beta x_2[n]\} = n^3(\alpha x_1[n] + \beta x_2[n])$
   $\alpha T\{x_1[n]\} + \beta T\{x_2[n]\} = \alpha n^3 x_1[n] + \beta n^3 x_2[n]$ > linear

2. $y[n]$ depends only on $x[n]$, causal.

3. Let $x[n] = 1 \ \forall n$ $\lim_{n\to\infty} |y[n]| = \infty$. not stable.

4. $T\{x[n-1]\} = n^2 x[n-1]$
   $y[n-1] = (n-1)^2 x[n-1]$ > not S.I.

c. $y[n] = \beta + \sum_{l=0}^{3} x[n-l]$

1. $T\{\alpha x_1[n] + \beta' x_2[n]\} = \beta + \sum_{l=0}^{3} (\alpha x_1[n] + \beta' x_2[n])$
   $\alpha T\{x_1[n]\} + \beta' T\{x_2[n]\} = \alpha\left(\beta + \sum_{l=0}^{3} x_1[n]\right) + \beta'\left(\beta + \sum_{l=0}^{3} x_2[n]\right)$
   $\Rightarrow$ not linear

2. $y[n]$ depends on $x[n]$ $x[n-1]$ $x[n-2]$ $x[n-3]$ causal.

3. Let $|x[n]| \le B_x < \infty \ \forall n$. Then
   $|y[n]| = \left|\beta + \sum_{l=0}^{3} x[n-l]\right| \le |\beta| + \sum_{l=0}^{3} |x[n-l]|$
   $\le |\beta| + \sum_{l=0}^{3} |B_x| = |\beta| + 4|B_x| = B_y < \infty \ \forall n$
   $\Rightarrow$ stable.

4. $T\{x[n-m]\} = \beta + \sum_{l=0}^{3} x[n-m-l]$
   $y[n-m] = \beta + \sum_{l=0}^{3} x[n-l-m]$
   The system is S.I.

d. causal, not linear, stable, S.I.

e. linear, not causal, stable, S.I.

f. linear, causal, stable, S.I.

2.47. If the system is L.TI, $y[n] = \sum_{k=-\infty}^{\infty} x[n-k]h[k]$

Any sequence can be written as a sum of impulses

$$x[n] = \sum_{k=-\infty}^{\infty} x[k]\,\delta[n-k] \qquad \delta[n] = \mu[n] - \mu[n-1]$$

$$= \sum_{k=-\infty}^{\infty} x[k]\left(\mu[n-k] - \mu[n-1-k]\right)$$

Let $S[n] = T\{\mu[n]\}$.

$$y[n] = T\{x[n]\} = T\left\{\sum_{k=-\infty}^{\infty} x[k]\mu[n-k] - \sum_{k=-\infty}^{\infty} x[k]\mu[n-1-k]\right\}$$

$$= \sum_{k=-\infty}^{\infty} x[k]\,S[n-k] - \sum_{k=-\infty}^{\infty} x[k]\,S[n-1-k]$$

2.48 $\tilde{x}[n] = \tilde{x}[n+N] \;\forall n.$

$$y[n+N] = \sum_{k=-\infty}^{\infty} \tilde{x}[k]\,h[n-k+N] \qquad \text{Let } m = k-N$$

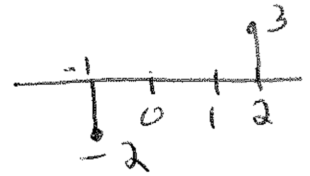
$$= \sum_{k=-\infty}^{\infty} \tilde{x}[m+N]\,h[n-m] = \sum_{k=-\infty}^{\infty} \tilde{x}[m]\,h[n-m] = y[n]$$

$y[n]$ is periodic with period N.

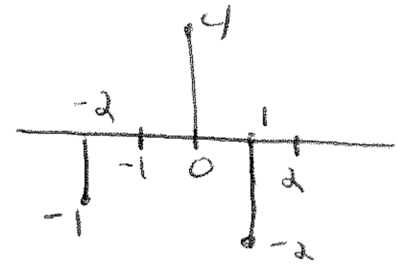
2.

2.49 a. $y_1[n] = x_1[n] * h_1[n]$

$x_1[n]$



$h_1[n]$



$$\begin{bmatrix} -2 & 0 & 0 & 0 \\ 0 & -2 & 0 & 0 \\ 0 & 0 & -2 & 0 \\ 3 & 0 & 0 & -2 \\ 0 & 3 & 0 & 0 \\ 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 3 \end{bmatrix} \begin{bmatrix} -1 \\ 0 \\ 4 \\ -2 \end{bmatrix} = \begin{array}{c} \begin{bmatrix} 2 \\ 0 \\ -8 \\ 1 \\ 0 \\ 12 \\ -6 \end{bmatrix} \end{array} \begin{array}{l} -3 \\ \\ \\ \leftarrow 0 \\ \\ \\ \\ \end{array}$$

b. $y_2[n] = x_2[n] * h_2[n] = -2\delta[n+2] + 9\delta[n-3] + 6\delta[n-4] +$
$7.5\delta[n-7] + 15\delta[n-8]$

2.51 $n_1 = -3 \quad n_2 = 4$ $\quad y[n]$ is defined for
$m_1 = 2 \quad m_2 = 6$

$-1 \le n \le 10 \qquad (-3+2 \le n \le 4+6)$

Length 12

2.52 $v[n] = y[n - N_1 - N_2]$

2.57 done in class

2.66 $y[n] = \sum_{k=-\infty}^{\infty} x[k]\, h[n-k]$ since $x[n]$ + $h[n]$ begin at $\underline{0}$

$y[0] = x[0]h[0] \Rightarrow x[0] = \frac{y[0]}{h[0]} = \frac{6}{2} = 3$

$y[1] = x[0]h[1] + x[1]h[0] \Rightarrow x[1] = \frac{y[1] - x[0]h[1]}{h[0]} = \frac{11 - 3(5)}{2}$

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

$y[2] = x[0]h[2] + x[1]h[1] + x[2]h[0]$

etc.

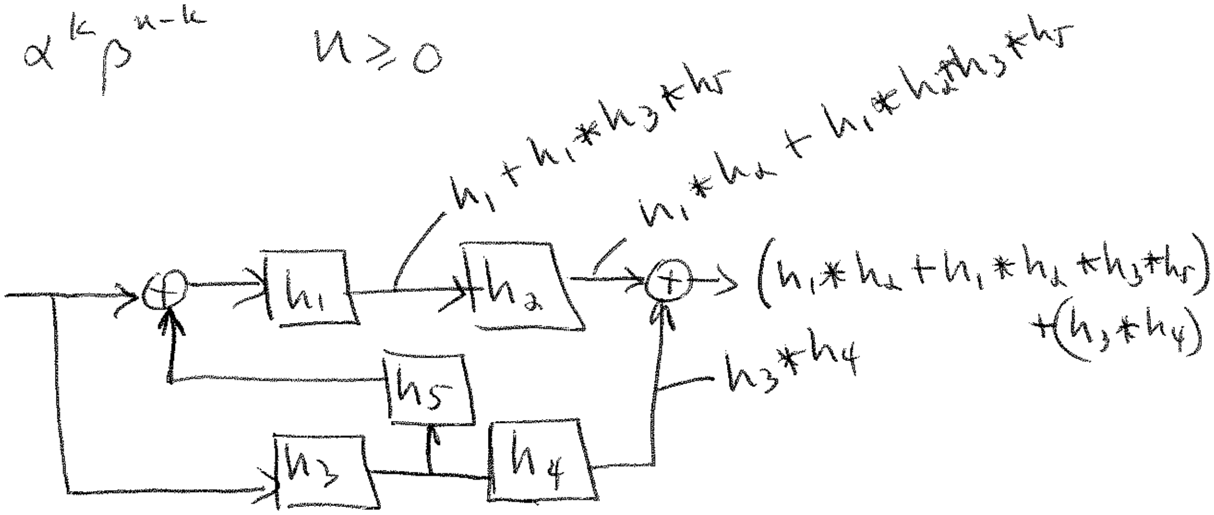
2.61 Two LTI systems in cascade.

$h_{eq} = h_1 * h_2$

$$\alpha^n \mu[n] * \beta \mu[n] = \sum_{k=-\infty}^{\infty} \alpha^k \mu[k] \beta^{n-k} \mu[n-k]$$

$$= \begin{cases} 0 & n < 0 \\ \sum_{k=0}^{n} \alpha^k \beta^{n-k} & n \geq 0 \end{cases}$$

2.64 a



2.86 $y[n] = x[n] + .35\, y[n-1]$

Similar to class problem, $h[n] = (.35)^n \mu[n]$

2.88 $y[n] = x[n] * h[n]$ for LTI system.

$x[n] = \mu[n]$

$h[n] = (-\alpha)^n \mu[n] \quad 0 < \alpha < 1$

$$y[n] = \sum_{k=-\infty}^{\infty} \mu[n-k] (-\alpha)^k \mu[k] = \sum_{k=0}^{\infty} \mu[n-k] (-\alpha)^k$$

$$= \begin{cases} \sum_{k=0}^{n} (-\alpha)^k & n \geq 0 \\ 0 & \text{else} \end{cases}$$

Class Problems

1. $h[n] = \delta[n] + \delta[n-3]$

$y[n] = x[n] * h[n] = x[n] + x[n-3]$

2. $y[n] = x[n] - .3\,y[n-1]$

$h[n] = (-.3)^n \mu[n]$

2.75 For stability of LTI system, $\sum_{n=-\infty}^{\infty} |h[n]| < \infty$

Cascade $h_{eq}[n] = h_1[n] * h_2[n] = \sum_{k=-\infty}^{\infty} h_1[k]\, h_2[n-k]$

$$\sum_{n=-\infty}^{\infty} |h_{eq}[n]| = \sum_{n=-\infty}^{\infty} \left| \sum_{k=-\infty}^{\infty} h_1[k]\, h_2[n-k] \right| \le \sum_{n=-\infty}^{\infty} \sum_{k=\infty}^{\infty} |h_1[k]|\,|h_2[n-k]|$$

$$= \sum_{k=-\infty}^{\infty} |h_1[k]| \left| \sum_{n=-\infty}^{\infty} |h_2[n-k]| \right| \le \sum_{k=-\infty}^{\infty} |h_1[n]|\, S_2 \le S_1 S_2 < \infty$$

2.76 $h_{eq}[n] = h_1[n] + h_2[n]$

$$\sum_{n=-\infty}^{\infty} |h_{eq}[n]| = \sum_{n=-\infty}^{\infty} |h_1[n] + h_2[n]| \le \sum_{n=-\infty}^{\infty} \left(|h_1[n]| + |h_2[n]| \right)$$

$$\le S_1 + S_2 < \infty$$

Class Problems

1 a. $h[n] = \delta[n] + \delta[n-1] + \delta[n+1]$

i. $h[n] \neq 0, n < 0$ not causal

ii. $\sum_{n=-\infty}^{\infty} |h[n]| = 3 < \infty$ stable

iii. $h[n]$ is FIR

b. $h[n] = \mu[n]$ i, $h[n] = 0, n < 0$ causal

ii $\sum_{n=-\infty}^{\infty} |h[n]| = \infty$ not stable

iii. $h[n]$ is IIR.

Class

1. $X(e^{j\omega}) = .3\omega + j.4\omega = .2.5\omega^2 e^{j1.35}$

2. a. $X_1(e^{j\omega}) = \frac{1}{1-.3e^{-j\omega}}$

b. $x_2[n]$ $X_2(e^{j\omega}) = \sum_{n=-\infty}^{\infty} .3^n \mu[n-1] e^{-j\omega n} = \sum_{n=1}^{\infty} .3^n e^{-j\omega n}$

$= \frac{.3e^{-j\omega}}{1-.3e^{-j\omega}}$

c. $X_3(e^{j\omega}) = \sum_{n=0}^{9} .3^n e^{-j\omega n} = \frac{1-.3e^{-j\omega(10)}}{1-.3e^{-j\omega}}$

d. $X_4(e^{j\omega}) = \sum_{n=1}^{9} .3^n e^{-j\omega n} = \frac{.3e^{-j\omega} - .3e^{-j\omega 10}}{1-.3e^{-j\omega}}$

e. $X_5(e^{j\omega}) = 1$

f. $X_6(e^{j\omega}) = \sum_{n=-\infty}^{\infty} \delta[n-1] e^{-j\omega n} = e^{-j\omega}$

g. $X_7(e^{j\omega}) = 1 + 3e^{-j\omega} + 7e^{-j3\omega}$

3.16

$$\sum_{n=\infty}^{\infty} A\alpha^n \sin(\omega_0 n + \phi)\mu[n]\, e^{-j\omega n}$$

$$= \frac{A}{2j} \sum_{n=-\infty}^{\infty} \alpha^n \left[e^{j(\omega_0 n + \phi)} - e^{-j(\omega_0 n + \phi)} \right] \mu[n] e^{-j\omega n}$$

$$= \frac{A}{2j} \left[\sum_{n=0}^{\infty} \alpha^n e^{-j(\omega - \omega_0)n} e^{j\phi} - \sum_{n=0}^{\infty} \alpha^n e^{-j(\omega + \omega_0)n} e^{-j\phi} \right]$$

$$= \frac{A}{2j} \left[\frac{e^{j\phi}}{1 - \alpha e^{-j(\omega - \omega_0)}} - \frac{e^{-j\phi}}{1 - \alpha e^{-j(\omega + \omega_0)}} \right]$$

3.17

a. $X_1(e^{j\omega}) = \sum_{n=-\infty}^{\infty} \alpha^n \mu[n-1] e^{-j\omega n} = \sum_{n=1}^{\infty} (\alpha e^{-j\omega})^n = \frac{\alpha e^{-j\omega}}{1 - \alpha e^{-j\omega}}$

b. $X_2(e^{j\omega}) = \sum_{n=-\infty}^{\infty} n \alpha^n \mu[n] e^{-j\omega n} = j \frac{d}{d\omega} \left(\frac{1}{1 - \alpha e^{-j\omega}} \right)$

$$= \frac{\alpha e^{-j\omega}}{(1 - \alpha e^{-j\omega})^2}$$

c. $X_3(e^{j\omega}) = \frac{(\alpha e^{-j\omega})^{-1}}{1 - \alpha e^{-j\omega}}$ (similar to part a)

d. same as b except

$$X_4(e^{j\omega}) = \sum_{n=-2}^{\infty} n\alpha^n e^{-j\omega n} = j\frac{d}{d\omega}\left(\frac{(\alpha e^{-j\omega})^2}{1-\alpha e^{-j\omega}}\right)$$

e. $$X_5(e^{j\omega}) = \sum_{n=-\infty}^{\infty} \alpha^n \mu[-n-1] e^{-j\omega n} = \sum_{n=-\infty}^{-1} \alpha^n e^{-j\omega n} = \sum_{k=1}^{\infty} \alpha^k e^{+j\omega k}$$

$$= \frac{\alpha e^{j\omega}}{1-\alpha e^{j\omega}}$$

f. $$X_6(e^{j\omega}) = \sum_{n=-M}^{M} \alpha^{|n|} e^{-j\omega n} = \sum_{n=-M}^{-1} \alpha^{-n} e^{-j\omega n} + \sum_{n=0}^{M} \alpha^n e^{-j\omega n}$$

$$= \sum_{k=1}^{M} \alpha^k e^{j\omega k} + \underbrace{\frac{1-(\alpha e^{-j\omega})^{M+1}}{1-\alpha e^{-j\omega}}} = \frac{\alpha e^{j\omega} - (\alpha e^{j\omega})^{M+1}}{1-\alpha e^{j\omega}} +$$

3.19 a. $$Y_1(e^{j\omega}) = \sum_{n=-N}^{N} e^{-j\omega n} = \frac{e^{-j\omega(-N)} - e^{-j\omega(N+1)}}{1-e^{-j\omega}}$$

$$= e^{j\omega N}\frac{1-e^{-j\omega(2N+1)}}{1-e^{-j\omega}} = e^{j\omega N}\frac{e^{-j\frac{\omega(2N+1)}{2}}\left(e^{j\frac{\omega(2N+1)}{2}} - e^{-j\frac{\omega(2N+1)}{2}}\right)}{e^{-j\frac{\omega}{2}}\left(e^{j\frac{\omega}{2}} - e^{-j\frac{\omega}{2}}\right)}$$

$$= \frac{e^{j\omega N} e^{-j\omega N} e^{-j\frac{\omega}{2}}}{e^{-j\frac{\omega}{2}}} \cdot \frac{2j\sin\left(\frac{\omega(2N+1)}{2}\right)}{2j\sin\left(\frac{\omega}{2}\right)} = \frac{\sin\left(\omega(N+\frac{1}{2})\right)}{\sin\left(\frac{\omega}{2}\right)}$$

c. $Y_3(e^{j\omega}) \Leftrightarrow y_3[n] = y_0[n] * y_2[n]$ where $y_0[n] = \begin{cases} 1 & |n| \le \frac{N}{2} \\ 0 & \text{else} \end{cases}$

So $Y_3(e^{j\omega}) = Y_0^2(e^{j\omega})$. From a $Y_0(e^{j\omega}) = \dfrac{\sin\left(\omega \frac{N+1}{2}\right)}{\sin\left(\frac{\omega}{2}\right)}$

and $Y_3(e^{j\omega}) = \dfrac{\sin^2\left(\omega \frac{N+1}{2}\right)}{\sin^2\left(\frac{\omega}{2}\right)}$

e. $$Y_f(e^{j\omega}) = \sum_{n=-N}^{N} \cos\left(\frac{\pi n}{2N}\right) e^{-j\omega n} = \sum_{n=-N}^{N} \frac{1}{2}\left(e^{j\frac{\pi n}{2N}} + e^{-j\frac{\pi n}{2N}}\right) e^{-j\omega n}$$

$$= \frac{1}{2} \sum_{n=-N}^{N} e^{-j\left(\omega - \frac{\pi}{2N}\right)n} + \frac{1}{2} \sum_{n=-N}^{N} e^{-j\left(\omega - \frac{\pi}{2N}\right)n}$$

$$= \frac{1}{2} \frac{e^{-j\left(\omega - \frac{\pi}{2N}\right)(-N)} - e^{-j\left(\omega - \frac{\pi}{2N}\right)(N+1)}}{1 - e^{-j\left(\omega - \frac{\pi}{2\pi}\right)}} + \frac{1}{2} \frac{e^{-j\left(\omega + \frac{\pi}{2N}\right)(-N)} - e^{-j\left(\omega + \frac{\pi}{2N}\right)(N+1)}}{1 - e^{-j\left(\omega + \frac{\pi}{2N}\right)}}$$

$$= \frac{1}{2} \frac{e^{-j\left(\omega - \frac{\pi}{2N}\right)\frac{1}{2}} \left[e^{j\left(\omega - \frac{\pi}{2N}\right)\left(N + \frac{1}{2}\right)} - e^{-j\left(\omega - \frac{\pi}{2N}\right)\left(N + \frac{1}{2}\right)} \right]}{e^{-j\left(\omega - \frac{\pi}{2N}\right)\frac{1}{2}} \left[e^{j\left(\omega - \frac{\pi}{2N}\right)\frac{1}{2}} - e^{-j\left(\omega - \frac{\pi}{2N}\right)\frac{1}{2}} \right]} +$$

$$\frac{1}{2} \frac{e^{-j\left(\omega + \frac{\pi}{2N}\right)\frac{1}{2}} \left[e^{j\left(\omega + \frac{\pi}{2N}\right)\left(N + \frac{1}{2}\right)} - e^{-j\left(\omega + \frac{\pi}{2N}\right)\left(N + \frac{1}{2}\right)} \right]}{e^{-j\left(\omega + \frac{\pi}{2N}\right)\frac{1}{2}} \left[e^{j\left(\omega + \frac{\pi}{2N}\right)\frac{1}{2}} - e^{-j\left(\omega + \frac{\pi}{2N}\right)\frac{1}{2}} \right]}$$

$$= \frac{1}{2} \frac{\sin\left(\left(\omega - \frac{\pi}{2N}\right)\left(N + \frac{1}{2}\right)\right)}{\sin\left(\left(\omega - \frac{\pi}{2N}\right)\frac{1}{2}\right)} + \frac{1}{2} \frac{\sin\left(\left(\omega + \frac{\pi}{2N}\right)\left(N + \frac{1}{2}\right)\right)}{\sin\left(\left(\omega + \frac{\pi}{2N}\right)\frac{1}{2}\right)}$$

~~3.20~~ 3.21

a. $$x_a[n] = \frac{1}{2\pi}\int_{-\pi}^{\pi}\sum_{k=-\infty}^{\infty}\delta(\omega-2\pi k)\, e^{j\omega n}\, d\omega$$

$$= \frac{1}{2\pi}\int_{-\pi}^{\pi}\delta(\omega)\, e^{j\omega n}\, d\omega = \frac{e^{j0n}}{2\pi} = \frac{1}{2\pi}$$

b. $$X_b(e^{j\omega}) = \frac{e^{j\omega} - e^{j\omega(N+1)}}{1-e^{j\omega}} = \sum_{n=1}^{N} e^{j\omega n}$$

so $$x_b[n] = \begin{cases} 1 & 1 \le n \le N \\ 0 & \text{else} \end{cases}$$

c. $$X_c(e^{j\omega}) = 1 + 2\sum_{\ell=0}^{N}\cos(\omega\ell) = \sum_{\ell=-N}^{N} e^{-j\omega\ell}$$

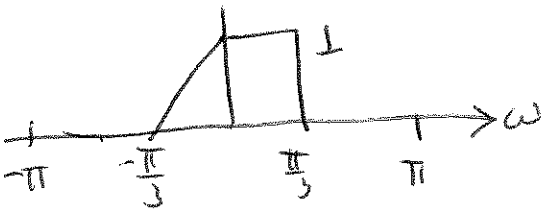
so $$x_c[n] = \begin{cases} 1 & |n| \le N \\ 0 & \text{else} \end{cases}$$

d. $\alpha^n \mu[n] \Longleftrightarrow \dfrac{1}{1-\alpha e^{-j\omega}}$ using ~~3.3~~ table 3.4

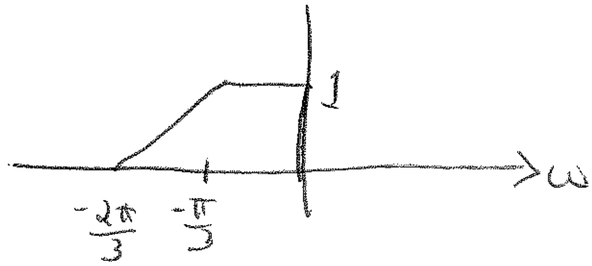
$x[n] = -jn\,\alpha^n \mu[n]$ and $x_d[n] = x[-n] = -j[-n]\alpha^n \mu[-n]$

3.35

$x[n] \Leftrightarrow X(e^{j\omega})$



$x[n]e^{-j\frac{\pi n}{3}} \Leftrightarrow X_1(e^{j\omega})$



3.41

$g_2[n] = g_1[n] + g_1[n-4] \Leftrightarrow G_2(e^{j\omega}) = G_1(e^{j\omega}) + G_1(e^{j\omega})e^{-j\omega 4}$

$g_3[n] = g_1[-n+3] + g_1[n-4] \Leftrightarrow$

$G_3(e^{j\omega}) = G_1(e^{-j\omega})e^{j\omega 3} + G_1(e^{j\omega})e^{-j\omega 4}$

$g_4[n] = g_1[n] + g_1[-n+7]$