SP - Assignment - 1:-

I affirm that I have neither given nor received help or used any means which would make this assignment unfair

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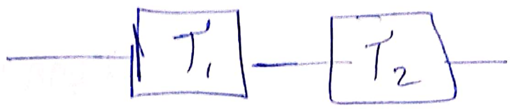
~~2023112026~~

20231120 26.

2.8(a-d), 2.10, 2.13, 2.16 b(8,9), 2.32, 2.35, 2.53

2.8 abcd

Q1)



a) if T_1 & T_2 are linear, then T is linear...

let for T_1 $\quad x_1 \xrightarrow{T_1} y_1$

$x_2 \xrightarrow{T_1} y_2$

By linearity

$\alpha x_1 + \beta x_2 \xrightarrow{T_1} \alpha y_1 + \beta y_2$ — (1)

Similarly Now if y_1 & y_2 are i/p for T_2

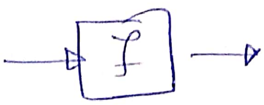
$y_1 \xrightarrow{T_2} z_1$

$y_2 \xrightarrow{T_2} z_2$

By linearity...

$\alpha y_1 + \beta y_2 \xrightarrow{T_2} \alpha z_1 + \beta z_2$ — (2)

So if T_1 & T_2 is replaced by a black box T we observe



$x_1 \xrightarrow{T} z_1$

$x_2 \xrightarrow{T} z_2$ (from above (1) & (2))

$\alpha x_1 + \beta x_2 \xrightarrow{T} \alpha z_1 + \beta z_2$ by the above (eq^n's

Hence the statement is true! Proved.

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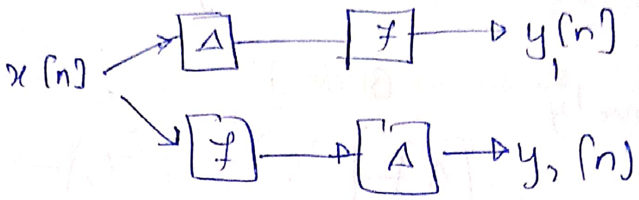
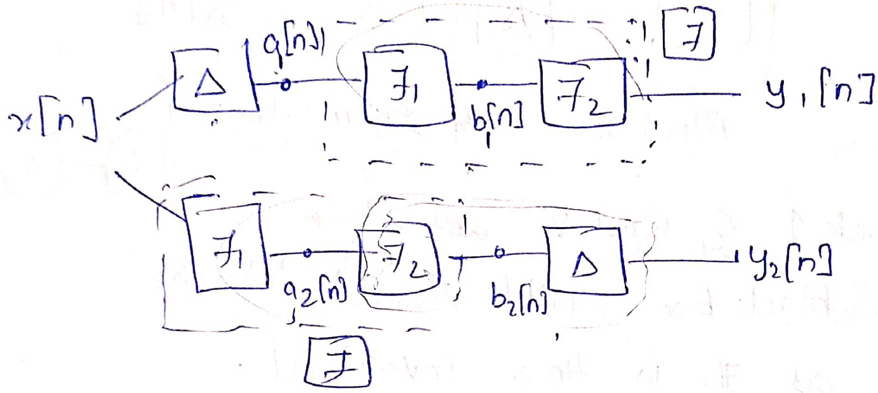
b) Given $\mathcal{T}_1$ & $\mathcal{T}_2$ are time invariant, then $\mathcal{T}$

for a time invariant sys,



$y_1[n] = y_2[n]$

We know $\mathcal{T}_1$ & $\mathcal{T}_2$ are time invariant, so ie $x[n] \to y[n]$ then $x[n-k] \to y[n-k]$



Backtracking relation b/w $y_1[n]$ & $x[n]$

~~$y_1[n]$~~

$a_1[n] = x[n-\Delta]$

Since $\mathcal{T}_1$ is time invariant,

if $a[n] \to b_1[n]$

then $a[n-k] \to b_1[n-k]$

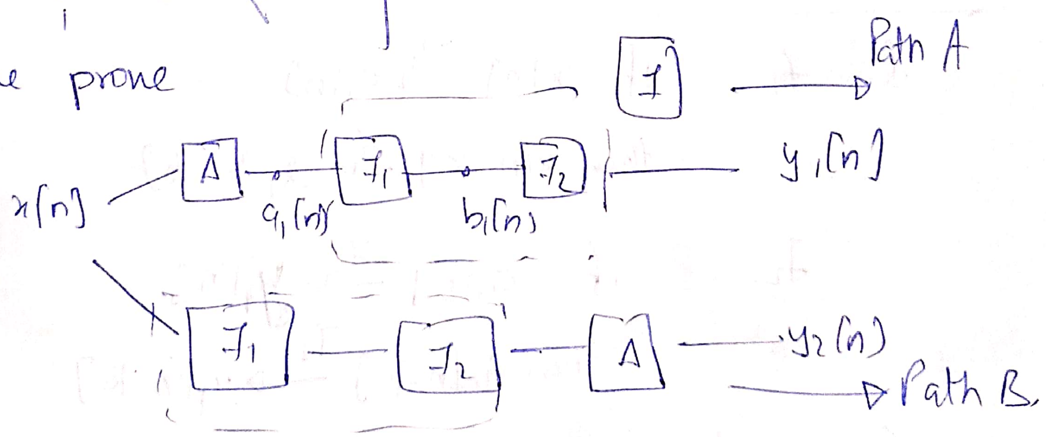
Back tracking relation b/w $y_2[n]$ & $x[n]$.

$y_2[n] = b_2[n-\Delta]$

$x[n] \xrightarrow{\mathcal{T}_1} a_2[n]$

$a_2[n] \xrightarrow{\mathcal{T}_2} b_2[n]$

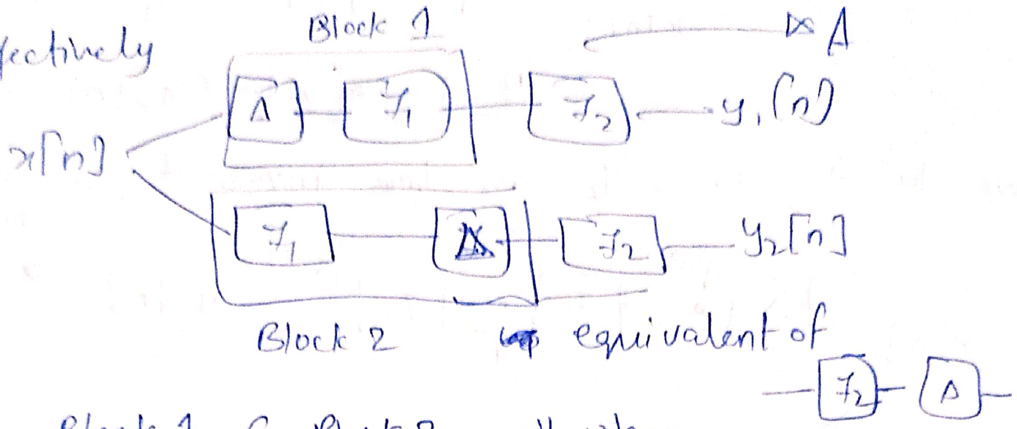
if we prove



if $y_1[n] = y_2[n] \longrightarrow$ it implies $\mathcal{T}_1$ & $\mathcal{T}_2$ cascade is also time invariant in Path B,

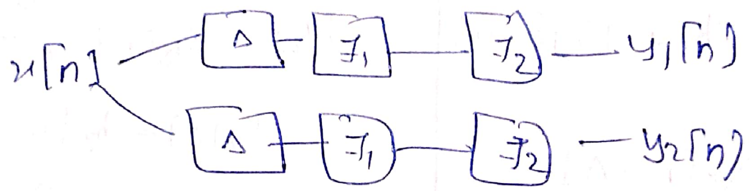
we can swap b/w $\boxed{\Delta}$ & $\boxed{\mathcal{F}_2}$ because $\mathcal{F}_2$ is time invariant system as assumed.

So effectively



Now Block 1 & Block 2 when treated as black box would result into the same o/p as $\mathcal{F}_1$ is time invariant.

So



Since both paths are same, o/p's are also same.

Hence Proved, it is true

Mathematical Proof:-

for $\mathcal{F}_1$ if $x[n] \xrightarrow{\mathcal{F}_1} a_1[n]$

then $x[n-k] \xrightarrow{\mathcal{F}_1} a_1[n-k]$

$\mathcal{F}_2$ if $a_1[n] \xrightarrow{\mathcal{F}_2} y_1[n]$

then $a_1[n-k] \xrightarrow{\mathcal{F}_2} y_1[n-k]$

So if $x[n] \xrightarrow[\mathcal{F}_1\mathcal{F}_2]{} y_1[n]$

$x[n-k] \xrightarrow[\mathcal{F}_1]{} a_1[n-k] \xrightarrow[\mathcal{F}_2]{} y_1[n-k]$

$= x[n-k] \xrightarrow[\mathcal{F}_1\mathcal{F}_2]{} y_1[n-k]$

Hence Proved, it is true

c) if T_1 & T_2 are causal systems, then T is causal.

if T_1 is causal $\Rightarrow$

$$a[n] = f(x[n], x[n-1] \ldots x[n-k])$$

$k \geq 0$

i.e. depends on prev values...

if T_2 is causal $\Rightarrow$

$x \to \boxed{T_1} \xrightarrow{a} \boxed{T_2} \to y$ $\quad y[n] = g(a[n], a[n-1] \ldots\ldots a[n-p])$

So if $T_1 T_2$ is a system, $\quad p \geq 0$

$$y[n] = g(a[n], a[n-1] \ldots a[n-p])$$

$y[n]$ depends on ~~a[p] a[n]~~ $a[n_2]$ where $n_2 \leq n$

and each $a[n_2]$ depends on $x[n_1]$ where $n_1 \leq n_2$

So

$$n_1 \leq n_2 \leq n$$

i.e. $\underline{n_1 \leq n}$, $\Rightarrow$ $y[n]$ depends on $x[n_1]$ where $n_1 \leq n$

hence the cascaded system is causal.

d) if T_1, T_2 are linear and time invariant,

if T_1 is LTI

$x_1[n] \xrightarrow{T_1} y_1[n]$

$x_2[n] \xrightarrow{T_1} y_2[n]$

$$\alpha x_1[n] + \beta x_2[n] \xrightarrow{T_1 T_2} \alpha y_1[n] + y_2[n]$$

&

$$x_1[n-k] \xrightarrow{T_1} y_1[n-k]$$

So

$$\alpha x_1[n-k] + \beta x_2[n-k] \xrightarrow{T_1} \alpha y_1[n-k] + \beta y_2[n-k]$$

Same is the case with T_2.

So if $x_1[n] \xrightarrow{\mathcal{F}_1} a_1[n] \xrightarrow{\mathcal{F}_2} y_1[n]$ $\quad x_2 \xrightarrow{\mathcal{F}_1} a_2$

$x_1[n-k] \xrightarrow{\mathcal{F}_1} a_1[n-k] \xrightarrow{\mathcal{F}_2} y_1[n-k]$

(By time invariance)

$\alpha x_1[n] \xrightarrow{\mathcal{F}_1} \alpha a_1[n] \xrightarrow{\mathcal{F}_2} \alpha y_1[n]$

(By linearity)

$\alpha x_1[n] + \beta x_2[n] \xrightarrow{\mathcal{F}_1} \alpha a_1[n] + \beta a_2[n]$

$\xrightarrow{\mathcal{F}_2} \alpha y_1[n] + \beta y_2[n]$

(By linearity)

So $x_1[n] \xrightarrow{\mathcal{F}_1\mathcal{F}_2} y_1[n]$

& $\alpha x_1[n] + \beta x_2[n] \xrightarrow{\mathcal{F}_1\mathcal{F}_2} \alpha y_1[n] + \beta y_2[n]$

and also $x[n-k] \xrightarrow{\mathcal{F}_1\mathcal{F}_2} y[n-k]$ (TI)

$\alpha x_1[n-k] + \beta x_2[n-k] \xrightarrow{\mathcal{F}_1\mathcal{F}_2} \alpha y_1[n-k] + \beta y_2[n-k]$

So $\mathcal{F}_1\mathcal{F}_2$ is a LTI System

→ Hence proved.

Q.2) 2.10.

$x_1[n] = \{\underset{\downarrow}{1}, 0, 2\} \xleftrightarrow{\mathcal{F}} y_1[n] = \{\underset{\uparrow}{0}, 1, 2\}$

$x_2[n] = \{\underset{\uparrow}{0}, 0, 3\} \xleftrightarrow{\mathcal{F}} y_2[n] = \{\underset{\uparrow}{0}, 1, 0, 2\}$

$x_3[n] = \{\underset{\uparrow}{0}, 0, 0, 1\} \xleftrightarrow{\mathcal{F}} y_3[n] = \{1, \underset{\uparrow}{2}, 1\}$

Since it is time invariant, $x(n) \xrightarrow{\mathcal{F}} y(n)$

$x(n-k) \longrightarrow y(n-k)$

$y[n] = \{ 1/2, \frac{3}{4}, 2, 4, \frac{23}{4}, \frac{13}{2}, 5, 2, 0, 0 \ldots \ldots 0 \}$

2.10]

Q2] Given T is TI

$$x_1[n] = \{1, 0, 2\} \xleftrightarrow{T} y[n] = \{0, 1, 2\}$$

$$x_2[n] = \{0, 0, 3\} \xleftrightarrow{T} y[n] = \{0, 1, 0, 2\}$$

$$x_3[n] = \{0, 0, 0, 1\} \xleftrightarrow{T} y[n] = \{1, 2, 1\}$$

A system is linear if

$$x_3 = \alpha x_1 + \beta x_2 \xrightarrow{T} y_3 = \alpha y_1 + \beta y_2.$$

So we will try to bring one ~~single~~ signal from 2 others,

Assume it is linear,

$$\frac{3}{2} x_1 - x_2 \longrightarrow \frac{3}{2} y_2 - y_1$$

$$\{3/2, 0, 0\} \quad \{0, 1/2, 3, 2\}$$

delay $\frac{3}{2}x_1 - x_2$ by 3 units

$\{0, 0, 0, \frac{3}{2}\} \longrightarrow \{0, 0, 0, 0, \frac{1}{2}, -\frac{3}{2}, \dots$

$$x_3 = \frac{2}{3}\left(\frac{3}{2}x_1[n-3] + x_2[n-3]\right)$$

$\{0, 0, 0, 1\} \longrightarrow \{0, 0, 0, 0, \frac{1}{3}, -2, \frac{4}{3}\}$

for same i/p, we get 2 different o/p,

So it is contradiction

$\boxed{\therefore \text{Non-linear}}$

∴ Non - linear

Q3] 2.13

Necessary condition :-

if A is true → B may be false
→ B may be true.

but if B is true ⇒ A is true.

Sufficient condition,

if A is true, B is ^must be^ true, but if B is true A mayn't be true

$$A \rightleftarrows B$$

Given to prove "Necessary & sufficient condition that relaxed LTI system to be BIBO stable is

$$\sum_{K=-\infty}^{\infty} |h[K]| \leq M_h < \infty$$

~~Necessary condition.~~

Sufficient condition:-

$$y[n] = \sum_{k=-\infty}^{\infty} x[k]\, h[n-k] \qquad (x[k]\, h[n-k] \in \mathbb{R})$$

$$|y[n]| = \left| \sum_{k=-\infty}^{\infty} x[k]\, h[n-k] \right|$$

$$|y[n]| = \left| \sum_{k=-\infty}^{\infty} x[k]\, h[n-k] \right| \leq \sum_{k=-\infty}^{\infty} |x[k]|\, |h[n-k]|$$

Since $|x[n]| \leq M_x < \infty$ as it is BIBO stable

$$|y[n]| \leq \sum_{k=-\infty}^{\infty} M_x\, |h[n-k]|$$

(if $a \leq c$ & $a \leq b$ then $a^2 \leq bc$)

$$|y[n]| \leq \underline{M_x \sum_{k=-\infty}^{\infty} |h[n-k]|}$$

we want this ~~cond~~ term to be bounded

ie $$\sum_{k=-\infty}^{\infty} |h[k]| < \infty$$

This is a sufficient condition as we have used various inequalities.

Necessary condition:-

To see whether necessary or not.

Given $\sum_{k=-\infty}^{\infty} |h[k]| \to \infty$, ~~then we~~ to show

than $y[n]$ may be unbounded,

So if we show one condition is satisfied that $y[n]$ is bounded, we can show it is necessary for BIBO Stability.

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

if $A \Rightarrow B$
then
if not $B \Rightarrow$ not A

$\cancel{x[n-k]}$

$$y[0] = \sum_{k=-\infty}^{\infty} x[-k]\, h[k]$$

$x(-k) = +1 \quad , h[k] \geq 0$

$x[-k] = -1 \quad h[k] < 0$

$$y[0] = \sum_{k=-\infty}^{\infty} |h[k]| \longrightarrow \infty$$

$\therefore$

$$\sum_{k=-\infty}^{\infty} |h[k]| < \infty$$

necessary & sufficient condition

which is a ...

$\Rightarrow$ if $\sum_{k=-\infty}^{\infty} |h[n-k]| \le M_y < \infty \Rightarrow$ released LTI system is BIBO stable.

$\hookrightarrow$ ~~Sufficient~~ Necessary condition $(A \Rightarrow B)$

Q4] 2.16 if $y[n] = x[n] * h[n] \Rightarrow \Sigma_y = \Sigma_x \Sigma_h$

$$\Sigma_x = \sum_{n=-\infty}^{\infty} x[n]$$

$$\Sigma_y = \sum_{n=-\infty}^{\infty} y[n] = \sum_{n=-\infty}^{\infty} \sum_{k=-\infty}^{\infty} x[k] h[n-k]$$

$$= \sum_{k=-\infty}^{\infty} x[k] \sum_{n=-\infty}^{\infty} h[n-k]$$

$$= x[1] \sum_{n=-\infty}^{\infty} h[n-1] + x[2] \sum_{n=-\infty}^{\infty} h[n-2] \ldots\ldots$$

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

b → 8) $x[n] = \{1, 1, 2\}$ $h[n] = u[n]$

$y[n] = x[n] * (\delta[n] \cdot u[n])$

$\cancel{u[n] = \sum \delta[}$

$$y[n] = \sum_{k=-\infty}^{\infty} x[n-k]\,u[k]$$

$(u[k] = 0 \text{ if } k < 0)$

$$= \sum_{k=0}^{\infty} x[n-k]$$

$x[n-k] = 0 \;\forall\; n-k \le 0$

$n < k$

$$y[0] = \sum_{k=0}^{\infty} x[0-k] \Rightarrow \begin{matrix} k \ge 0 \\ -k \le 0 \\ \text{so} \end{matrix}$$

$y[0] = 1$

$$y[1] = \sum_{k=0}^{\infty} x[1-k] \Rightarrow \begin{matrix} k \ge 0 \\ k-1 \ge (-1) \\ 1-k \le 1 \end{matrix}$$

$$= x[1] + x[1-1] + \underbrace{\sum_{k=2}^{\infty} x[1-k]}_{0}$$

$= 1 + 1 = 2$

$$y[2] = x[0] + x[1] + x[2] + \underbrace{\sum_{k=3}^{\infty} x[2-k]}_{0}$$

$= 4$

$$y[3] = \cancel{x[0]} + x[0] + x[1] + x[2] + \underbrace{\sum_{k=4}^{\infty} x[3-k]}_{0}$$

$y[0] = 1$

$y[1] = 2$

$y[n] = 4 \;\forall\; n \ge 2$

$= 0$ else if $n < 0$

$\{1, 2, 4, 4, \ldots\}$

Testing through $\Sigma_y = \Sigma_x \Sigma_h$

$$\text{LHS: } \sum_{k=-\infty}^{\infty} y[k] = \underbrace{\sum_{k=-\infty}^{-1} y[k]}_{0} + y[1] + \sum_{k=2}^{\infty} y[n] + y[0]$$

$$= 3 + \sum_{k=2}^{\infty} (4) \rightarrow \infty$$

RHS: $\sum_{k_1=-\infty}^{\infty} x[k_1] \sum_{k_2=-\infty}^{\infty} h[k] = \left(\cancel{0\Big|_{k=-\infty} + 2 + \sum_{k=2}^{\infty} 4} \right) \cdot \left(\cancel{\sum_{0}^{\infty} 1} \right)$

$= \left(0\Big|_{-\infty}^{-1} + 1 + 1 + 2 + 0\Big|_{3}^{\infty} \right) \left(\sum_{0}^{\infty} 1 \right) \to \infty$

So LHS = RHS

Q(b → 9)) $x[n] = \{\overset{-2}{1}, 1, \underset{\uparrow}{0}, 1, \overset{2}{1}\}$ $\quad h(n) = \{\overset{-3}{1}, -2, -3, \underset{\uparrow}{\overset{0}{4}}\}$

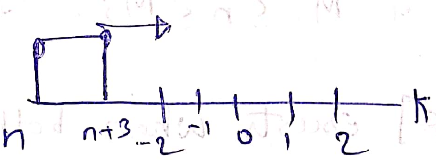
$y[n] = \sum_{-\infty}^{\infty} x[k] h[n-k]$

$h[n-k]$ exists from $n-k \in [-3, 0]$

$n-k \in [-3, 0]$

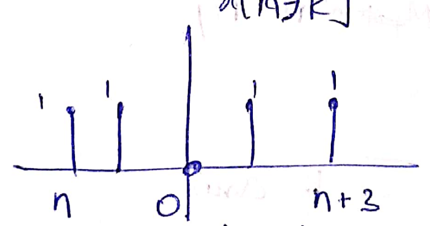
$k-n \in [0, 3]$

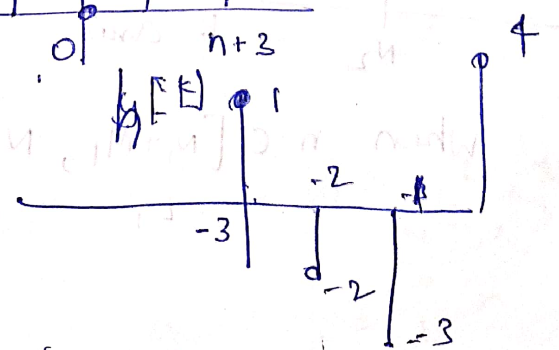
$x[k]$ exists when $k \in [-2, 2]$ && $k \in [n, n+3]$



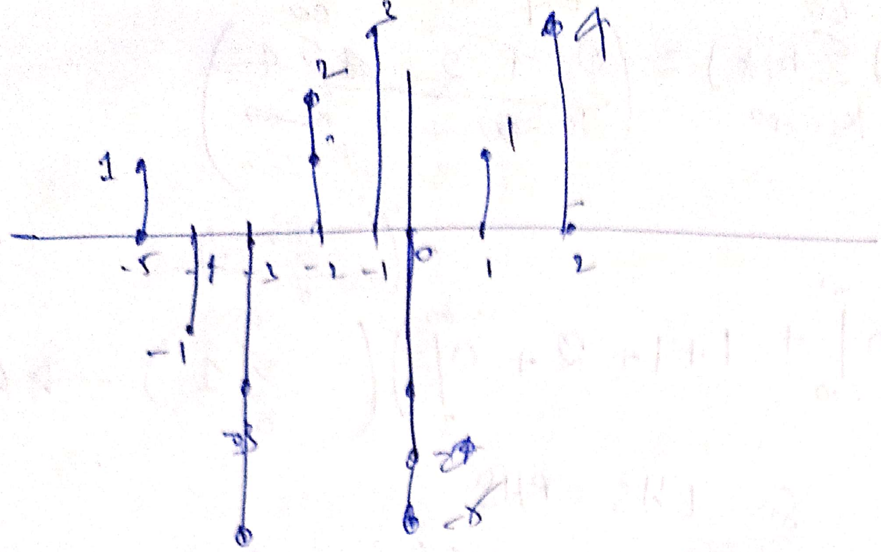
y[n] exists when $n+3 = -2$ to $n = 2$

$n = -5$





$\to$ 1, −1, −5, 2, 3, −5, 1, 4



Testing LHS: $\sum_{n=-\infty}^{\infty} y(n) = 0$

RHS

$$\left(\sum_{k=-\infty}^{\infty} x[k] = 4\right) \cdot \left(\sum_{k=-\infty}^{\infty} h[k] = 0\right) = 0$$

$$\boxed{LHS = RHS}$$

Hence Proved

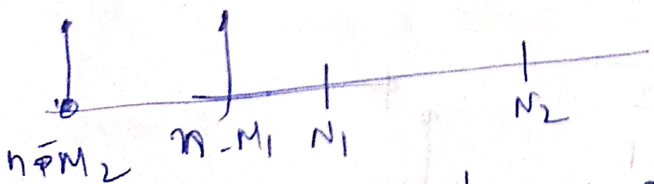
Q.5) 2.32

a) $x(n)$ exists when $N_1 \le n \le N_2$ } finite
$h[n]$ " " $M_1 \le n \le M_2$

$y[n] = \sum x[k]\,h[n-k]$ exists when both statements are true

$N_1 \le k \le N_2$ & $M_1 \le n-k \le M_2$

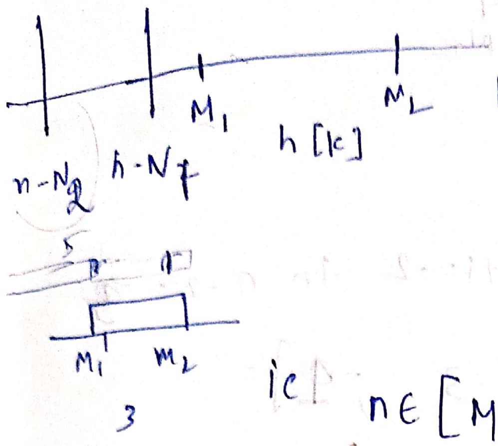
$\Rightarrow n - M_2 \le k \le n - M_1$



$y[n]$ exists when $n \in [N_1+M_1,\ N_2+M_2]$
L_1 L_2

b) if $h[n]$ has shorter duration

ie $|M_2 - M_1| \le |N_2 - N_1|$



for extreme partial overlap from left

$n - N_1 = M_2 - 1$ (last partial left overlap)

&

$n - N_1 = M_1$ (first partial left overlap)

ie $n \in [M_1 + N_1, N_1 + M_2 - 1]$

for complete overlap

first complete overlap, $n - N_1 = M_2$

last complete overlap $n - N_2 = M_1$

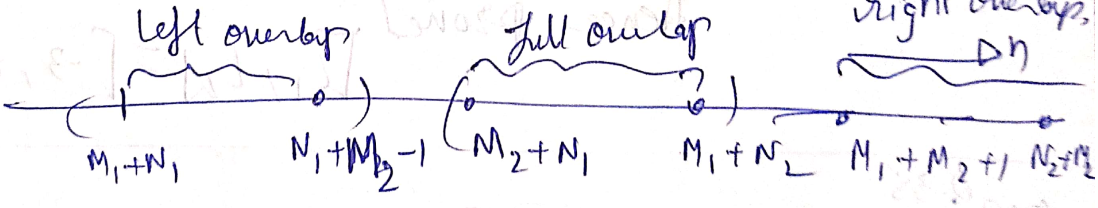
ie $n \in [M_2 + N_1, M_1 + N_2]$

for partial right overlap,

first partial right $\Rightarrow$ $n - N_2 = M_1 + 1$

last " " $\Rightarrow$ $n - N_2 = M_2$

$n \in [M_1 + N_2 + 1, N_2 + M_2]$



c) $x(n) = \begin{cases} 1 & -2 \le n \le 4 \\ 0 & \text{else} \end{cases}$

$= \{1, 1, 1, 1, 1, 1, 1\}$
$\quad -2, -1, 0, 1, 2, 3, 4$

$h[n] = \begin{cases} 2 & -1 \le n \le 2 \\ 0 & \text{else} \end{cases} = \{2, 2, 2, 2\}$
$\quad -1, 0, 1, 2$

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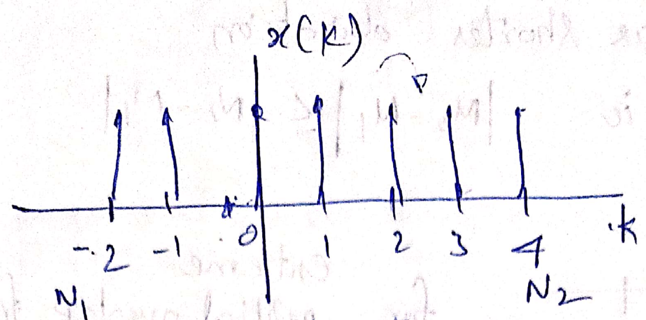
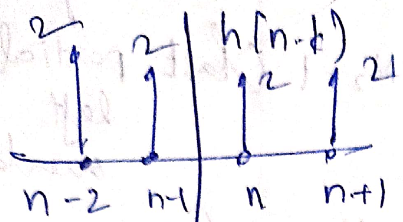




$n+1=-2$ to $n-2=-3$

Left overlap when $n \in [-3, -1]$ =

~~right~~ full overlap when ~~n∈~~ $n-2=-2$ $n+1=4$
$n \in [0, 3]$

right overlap when $n+1=5$ $n-2=4$
$n \in [4, 6]$

$N_1=-2$ | $M_1=-1$
$N_2=4$ | $M_2=2$

Left overlap, when $n \in [M_1+N_1, N_1+M_2-1] = [-3, -1]$

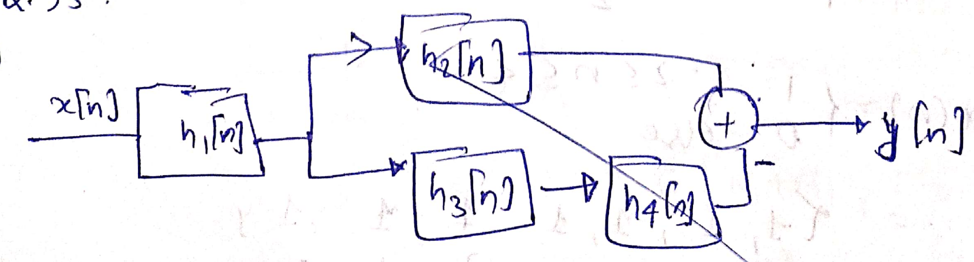
~~righ~~ full M_1+M_2, M_1+N_2
$n \in [0, 3]$

right $n \in M_1+N_2+1$ M_2+M_2
$[4, 6]$

Hence proved

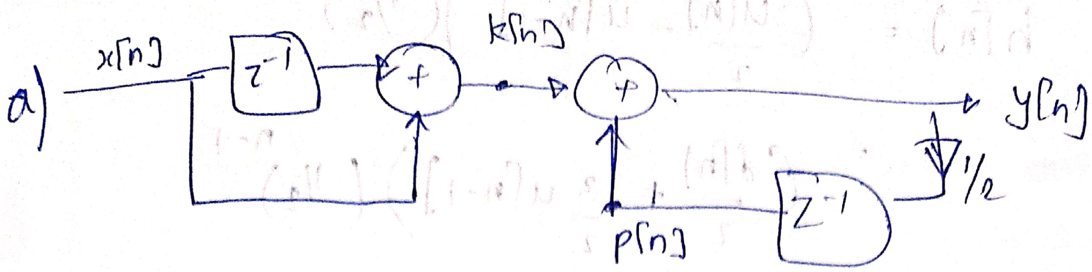
$[L_1, L_2] = [-3, 6]$

Q6] 2.35.



Q7) P.83

a)



$k[n] = x[n-1] + x[n]$

$\cancel{y[n] = \frac{1}{2} y[n] +}$

$p[n] = \frac{1}{2} y[n-1]$

$y[n] = \frac{1}{2} y[n-1] + x[n-1] + x[n]$ //

$h[n] = \frac{1}{2} h[n-1] + \delta[n-1] + \delta[n]$ //

$h[0] = \cancel{\frac{1}{2} h[-1]} + \cancel{\delta[-1]} + \delta[0]$

$h[0] = 1$

$h[1] = \frac{1}{2}(1) + 1 + 0 = 3/2$

$h(2) = \frac{1}{2}(3/2) + 0 = 3/4$

$h[3] = 1/2(3/4) = 3/8 = 3/$

$$\boxed{h[n] = 3/2^n \, u(n-1) + \delta[n]}$$

b) Show $h[n] = h_1[n] * h_2[n]$

where $h_1[n] = \delta[n] + \delta[n-1]$, $h_2[n] = (1/2)^n u[n]$

$h[n] = ((1/2)^n u[n]) * (\delta[n] + \delta[n-1])$

$= (1/2)^n u[n] + (1/2)^{n-1} u[n-1]$

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

$\cancel{h[n] =}$

$$h[n] = \left(\frac{u[n]}{2} + u[n-1]\right)\left(\tfrac{1}{2}\right)^{n-1}$$

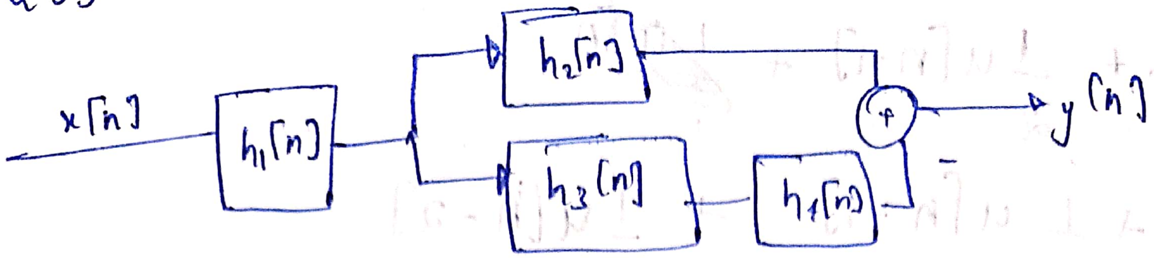
$$= \left(\frac{\delta[n]}{2} + \frac{3}{2}u[n-1]\right)\left(\tfrac{1}{2}\right)^{n-1}$$

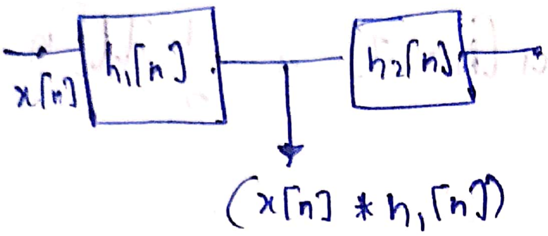
$$= \frac{\delta[n]}{2^n} + \frac{3}{2^n}u[n-1]$$

$$\boxed{h[n] = \delta[n] + \frac{3}{2^n}u[n-1]}$$

2 2 4

Q6) 2.35





$$(x[n] * h_1[n]) * h_2[n]$$
$$= x[n] * \underbrace{(h_1[n] * h_2[n])}_{heff[n]}$$

a) $h_{eff}[n] = (h_2[n] - h_3[n] * h_4[n]) * h_1[n]$

b) $h_1[n] = \{\frac{1}{2}, \frac{1}{4}, \frac{1}{2}\} = \frac{1}{2}\delta[n] + \frac{1}{4}\delta[n-1] + \frac{1}{2}\delta[n-2]$

$h_2[n] = h_3[n] = (n+1)\,u[n]$

$h_4[n] = \delta[n-2]$.

$$h[n] = \Big((n+1)u[n] - \overset{h[n]}{\boxed{(n+1)u[n]}} * \delta(n-2)\Big) * h_1[n]$$

$$= \big((n+1)u[n] - (n-1)u[n-2]\big) * h_1[n]$$

$$= \big(n[u[n] - u[n-2]) + u[n] + u[n-2]\big) * h_1[n]$$

$$n(u[n]-u[n-2]) = n(\delta[n]+\delta[n-1])$$

$$= \underbrace{\cancel{n\delta[n]}}_{0} + \underbrace{n\,\delta[n-1]}_{\delta[n]}$$

$$= \delta[n-1]\,(1)$$

$$h[n] = \left(\delta[n-1] + u[n]+u[n-2]\right) * h_1[n]$$

$$= \left(u[n]+u[n-1]\right) * h_1[n]$$

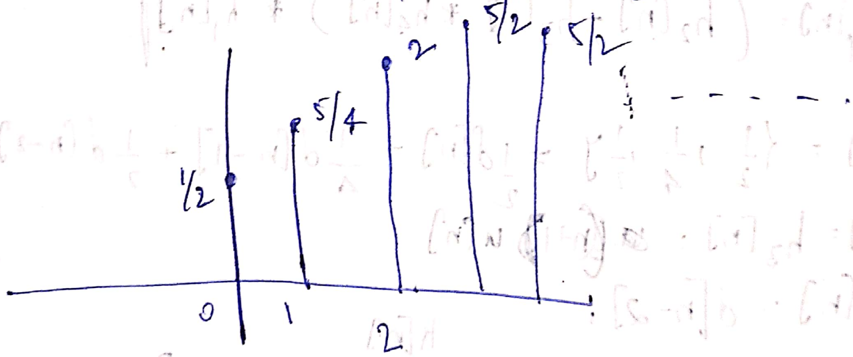
$$= \left(u[n]+u[n-1]\right) * \left(\frac{1}{2}\delta[n] + \frac{1}{4}\delta[n-1] + \frac{1}{2}\delta[n-2]\right)$$

$$= \frac{1}{2}u[n] + \frac{1}{2}u[n-1] +$$

$$+ \frac{1}{4}u[n-1] + \frac{1}{4}u[n-2]$$

$$+ \frac{1}{2}u[n-2] + \frac{1}{2}u[n-3]$$

$$= \frac{1}{2}u[n] + \frac{3}{4}u[n-1] + \frac{3}{4}u[n-2] + \frac{1}{2}u[n-3]$$



c) $x[n] = \delta[n+2] + 3\delta[n-1] - 4\delta[n-3]$

$$x[n] * h[n] = \left(\tfrac{1}{2}u[n] + \tfrac{3}{4}u[n-1] + \tfrac{3}{4}u[n-2] + \tfrac{1}{2}u[n-3]\right)$$

$$* \left(\delta[n+2] + 3\delta[n-1] - 4\delta[n-3]\right)$$

$$y[n] = \frac{1}{2}u[n+2] + \frac{3}{4}u[n+1] + \frac{3}{4}u[n] + \frac{1}{2}u[n-1]$$

$$\frac{3}{2}u[n-1] + \frac{9}{4}u[n-2]$$

$$+ \frac{9}{4}u[n-3]$$

$$- 2u[n-3] - 3u[n-4]$$

$$+ 3/2\, u[n-4]$$

$$- 3u[n-5]$$

$$- 2u[n-6]$$

$$y[n] = \frac{1}{2}u[n+2] + \frac{3}{4}u[n+1] + \frac{3}{4}u[n] + 2u[n-1] + \frac{9}{4}u[n-2] + \frac{1}{4}u[n-3]$$

$$- 3/2\, u[n-4] - 3u[n-5] - 2u[n-6] \,//$$

$$y[n] = \{ 1/2, \frac{5}{4}, 2, 4, \frac{25}{4}, \frac{13}{2}, 5, 2, 0, 0 \ldots\ldots 0 \}$$

2.10)