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$\boxed{\text{Set - C}}$

Q.1

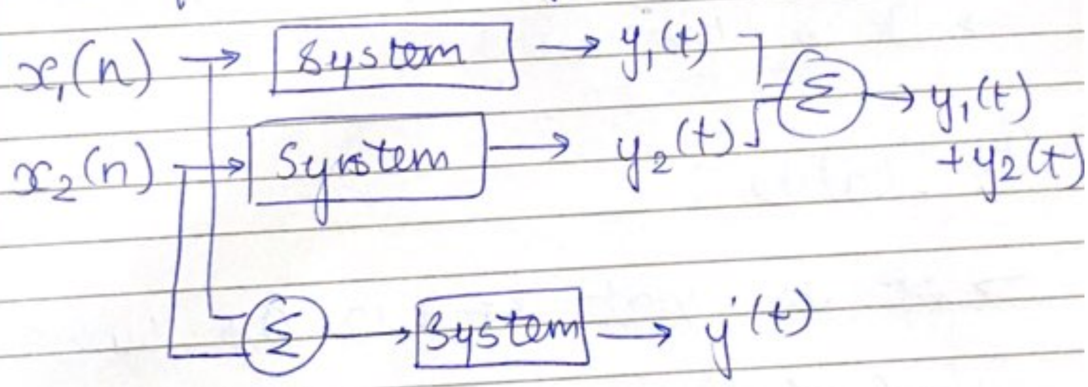
a) $y(n) = nx(n) + x(n+2) + y(n-2)$

$\therefore y(n) - y(n-2) = nx(n) + x(n+2)$

① Linear or Non-linear

Let $y(n) - y(n-2)$ be a System

$\therefore$ (i) Law of additivity



In this case,

$$\underbrace{y_1(n) - y_1(n-2)}_{y_1'(n)} = nx_1(n) + x_1(n+2)$$

$$\underbrace{y_2(n) - y_2(n-2)}_{y_2'(n)} = nx_2(n) + x_2(n+2)$$

$$y_1'(n) + y_2'(n) = nx_1(n) + x_1(n+2) + nx_2(n) + x_2(n+2)$$

Now ~~transforming~~ adding first,

$x_1(n) + x_2(n) \Rightarrow nx_1(x) + n x_2(n)$
$+ x_1(n+2) + x_2(n+$

Hence, it is ~~ad~~ additive.

Now, homogenity.

$y'(n) = y(n) - y(n-2)$

$\therefore$ ~~x~~ $y(n) = k[x(n) + n x(n)]$

Also $Rx(n) \Longrightarrow \boxed{syst}\ y(n)$

Hence, it is homogeneous.

$\rightarrow$ It is linear

(2) Stable

$\rightarrow$ It is not stable as unbounded $n(x(n))$ keeps growing

(3) Causal

$\rightarrow$ It is not causal. As dependent on future value.

b) $y(n) = x(n^2) + x(-n)$

(1) Linear.

$x(n) \rightarrow x(n^2) + x(-n) \Rightarrow k(x(n^2) + x(-n))$

$k(x(n)) \rightarrow k(x(n^2) + x(-n))$

Homogeneous.

$\rightarrow$ Linear

(2) Unstable

(3) Causal.

Q.2 Differences between linear and circular convolution.

① Linear Convolution

→ It is done to get output of any LTI system. (Linear Time Invariant) which gives its input and impulse response

→ Applicable to continous and discrete time signals.

→ In this both the sequences may or may not have equal length. Hence, output can have or ~~not~~ may not have same samples as input.

→ Represented as $y(n) = x(n) * h(n)$

$$y(n) = \sum_{n=-\infty} x(k)\, h(n-k).$$

→ Output of linear convolution may or may not be periodic.

② Circular Convolution

→ It is same as linear convolution but here all the signals are periodic.

→ Applicable to both continous and ~~time~~ domain signals.

→ In this both sequences must have equal length. Hence, output contains same no. of samples are input sequence.

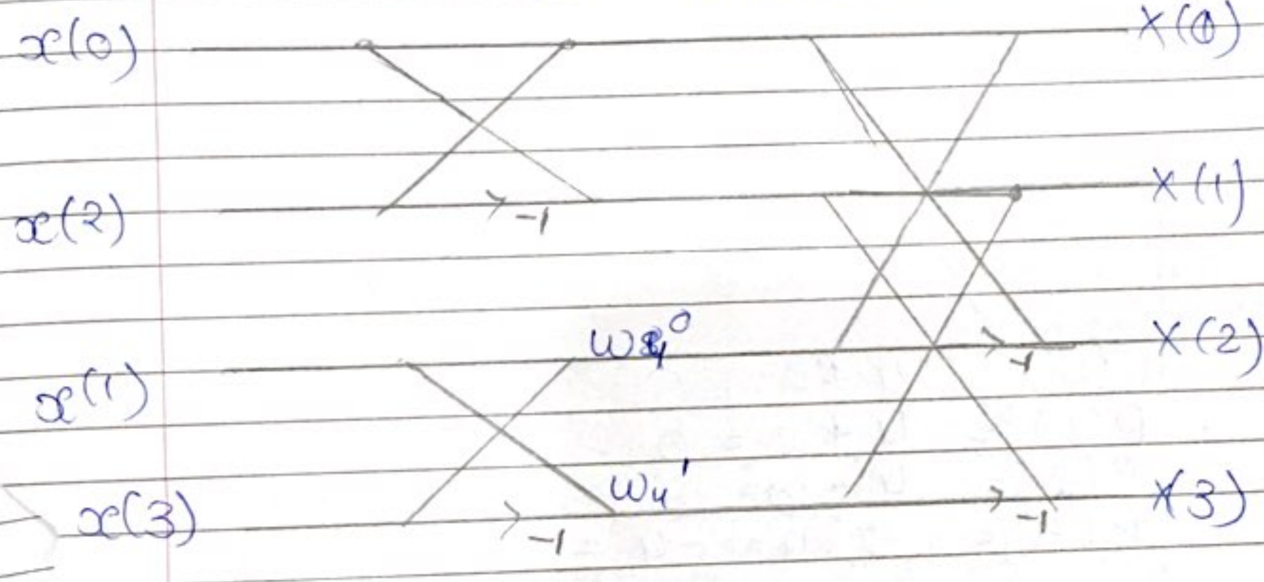
→ Represented as $y(n) = x(n) \circledast h(n)$
Here $y(n)$ is periodic output. $x(n)$ periodic input and $h(n)$ is periodic impulse response.

→ The output is always periodic. The period is equal to period of any one input.

Q.3

a) $X(k) = \{4, 2, 0, 4\}$

DFT structure



0, 1, 2, 3

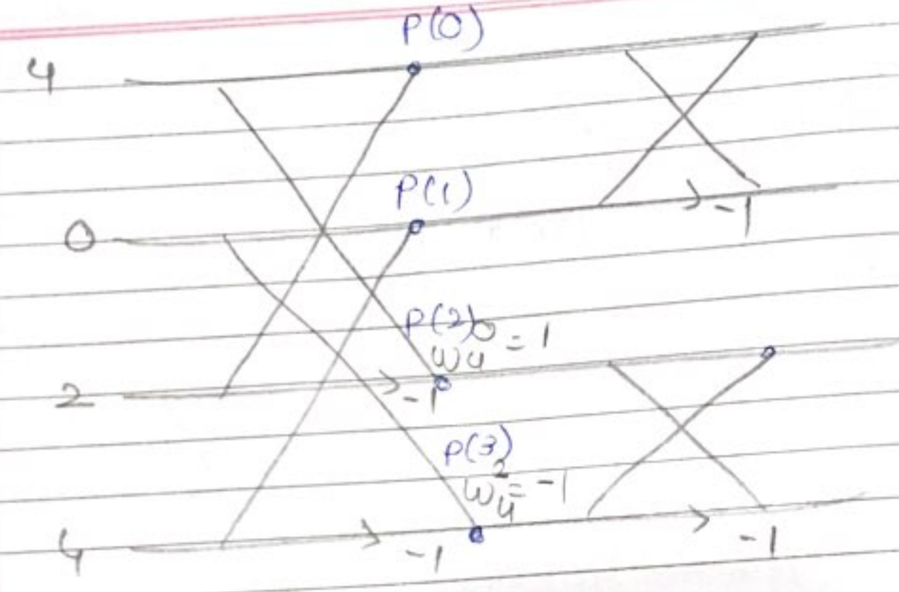
0, 2, 1, 3

DFT : $X(k) = \sum_{n=0}^{N-1} x(n) e^{-j\frac{2\pi k n}{N}}$

IDFT : $x(n) = \frac{1}{N} \sum_{n=0}^{N-1} x(k) e^{j\frac{2\pi k n}{N}}$

4 2 0 4

4 0 2 4



$P(0) = 4+2 = 6$

$P(1) = 4+0 = 0$

$P(2) = 4-2 = 2 = 2(w_4^0) = 2$

$P(3) = 0-4 = -4 = -4(w_4^2) = 4$

$x(0) = 6+0 = 6$

$x(1) = 6-0 = 6$

$x(2) = 2+4 = 6$

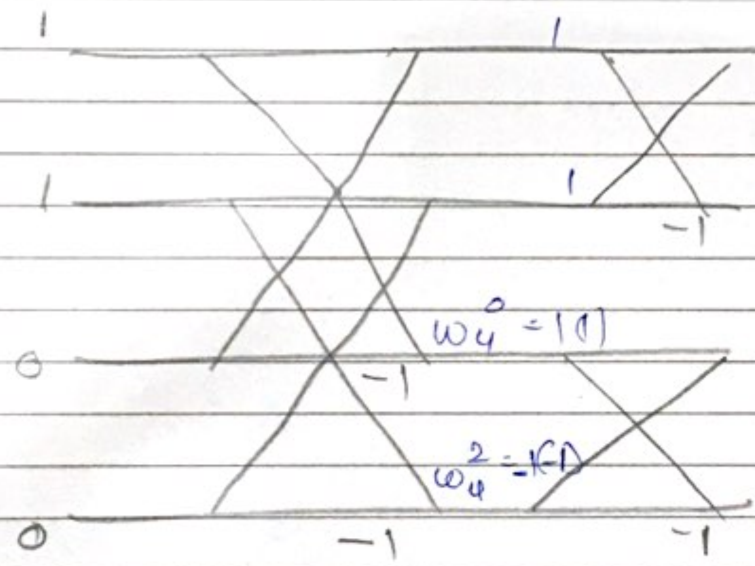
$x(3) = 2-4 = -2$

IDFT $= \{6, 6, 6, -2\}$

Q.3

b) $X(k) = \{1, 0, 1, 0\}$

$x(0) = 1$
$x(1) = 0$
$x(2) = 1$
$x(3) = 0$



$P(0) = 1$
$P(1) = 1$
$P(2) = 1 \quad = (1)(1) = 1$
$P(3) = 1 \quad = (1)(-1) = -1$

$\therefore x(0) = 2$
$x(1) = 0$
$x(2) = 0$
$x(3) = 2$

IDFT $= \{2, 0, 0, 2\}$