Assignment-2

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find circular convolution between these sequences.

i) $x_1[n] = \{3, 5, 4, 7\}$ and $x_2[n] = [-5, 2, 1, 6]$

~~Ex~~ Example qn:

find circular convolution of

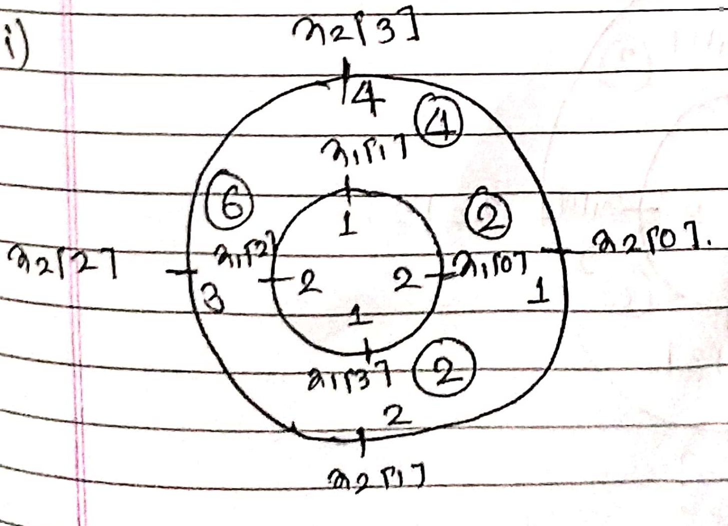
$x_1[n] = \{2, 1, 2, 1\}$ and $x_2[n] = \{1, 2, 3, 4\}$

Circular convolution,

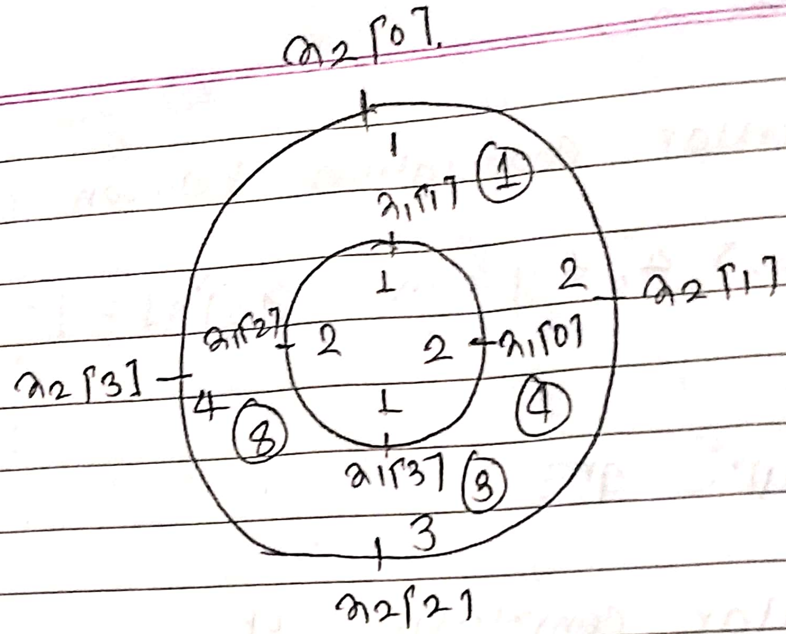
$$y[n] = \sum_{n=0}^{N-1} x_1(n).x_2((m-n))_N$$

Stockham's Method.

i)

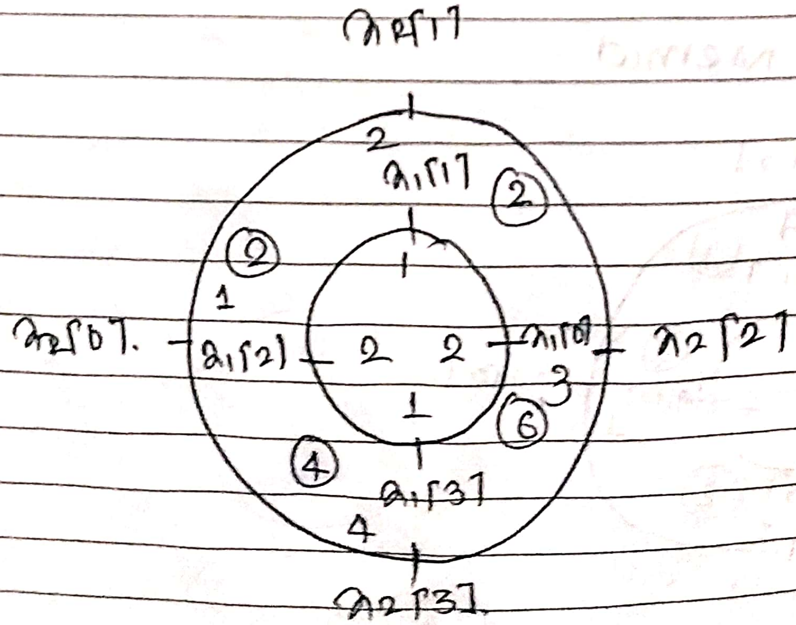


$y[0] = 2+4+6+2$
$= 14$

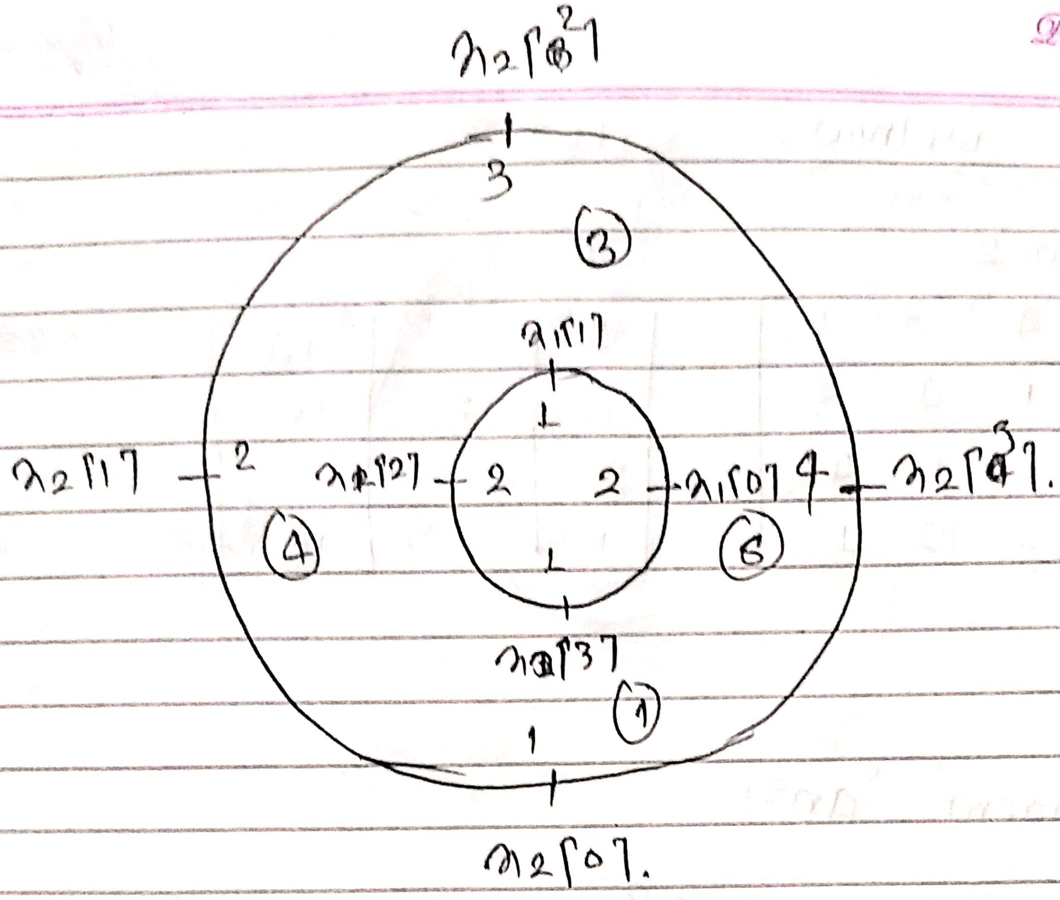


$$y_1[0] = 1 + 4 + 3 + 8$$
$$= 16.$$

for y_2.



$$y[2] = 2 + 6 + 4 + 2 = 14.$$



$$y[3] = 4+3+8+1$$
$$= 16.$$

$$y[n] = \{14, 16, 14, 16\}.$$

complete ,,

Matrix Method.

Method 2.

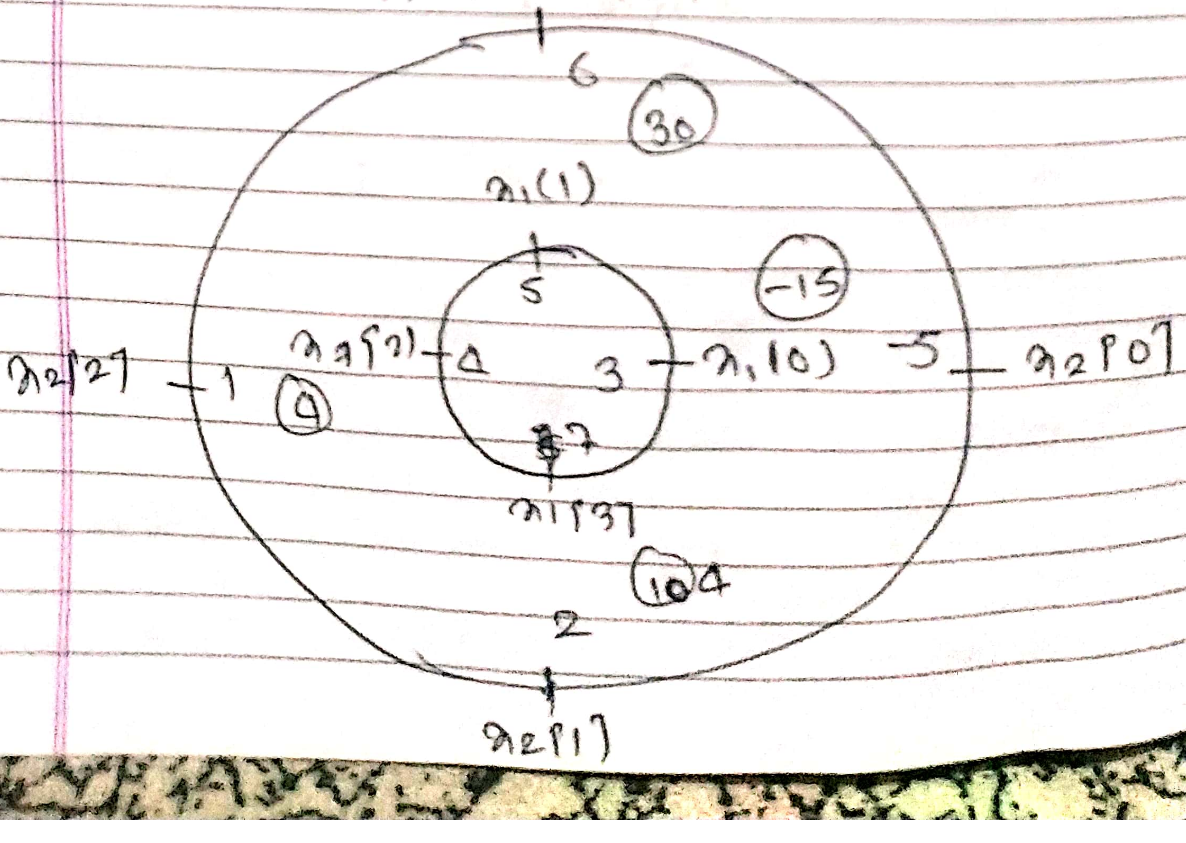
$$\begin{bmatrix} 1 & 4 & 3 & 2 \\ 2 & 1 & 4 & 3 \\ 3 & 2 & 1 & 4 \\ 4 & 3 & 2 & 1 \end{bmatrix} \begin{bmatrix} 2 \\ 1 \\ 2 \\ 1 \end{bmatrix} = \begin{bmatrix} 14 \\ 16 \\ 14 \\ 16 \end{bmatrix}$$

Assignment ans:

$x_1[n] = \{3, 5, 4, 7\}$ and $x_2[n] = \{-5, 2, 1, 6\}$

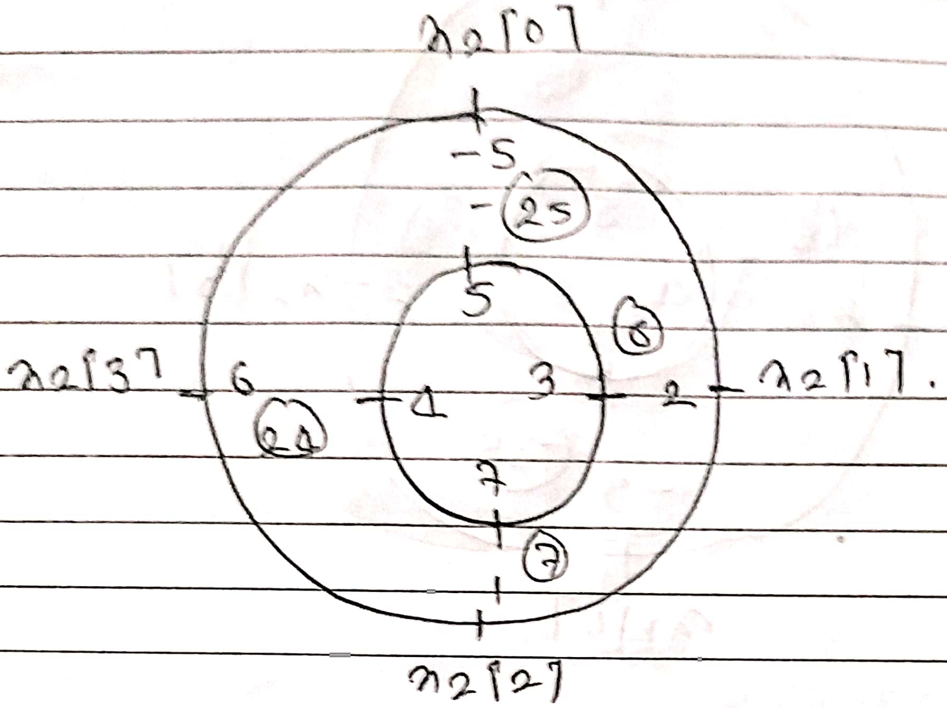
Circular Convolution.

$$y[n] = \sum_{n=0}^{N-1} x_1(n) \cdot x_2(m-n)_N$$



$y[0] = [-15 + 30 + 4 + 10].$

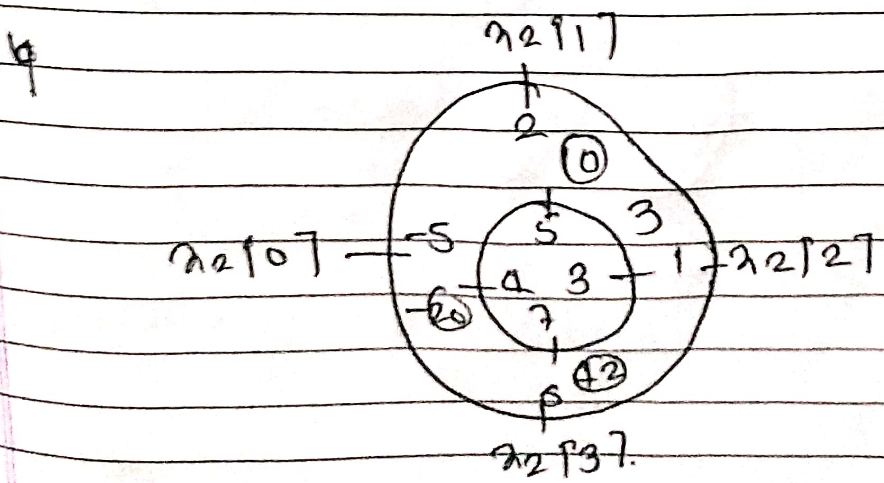
$= 33$



$y[1] = -25 + 24 + 7 + 6$

$= -1 + 7 + 6$

$= 12.$



$y[2] = 10 + 3 + 42 - 20$

$= 35$

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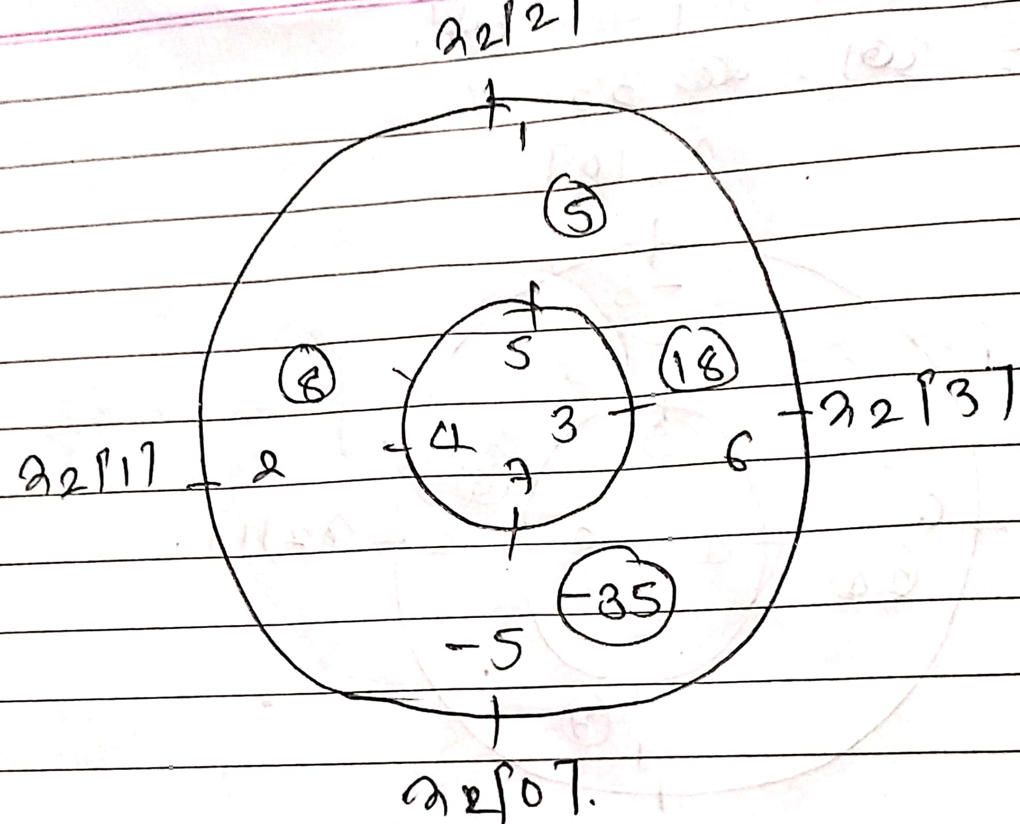


$y[3] = 5 + 18 - 35 + 8$
$= -4.$

$\therefore\ y[n] = [\overset{43}{\cancel{39}},\ 12,\ 35,\ -4].$

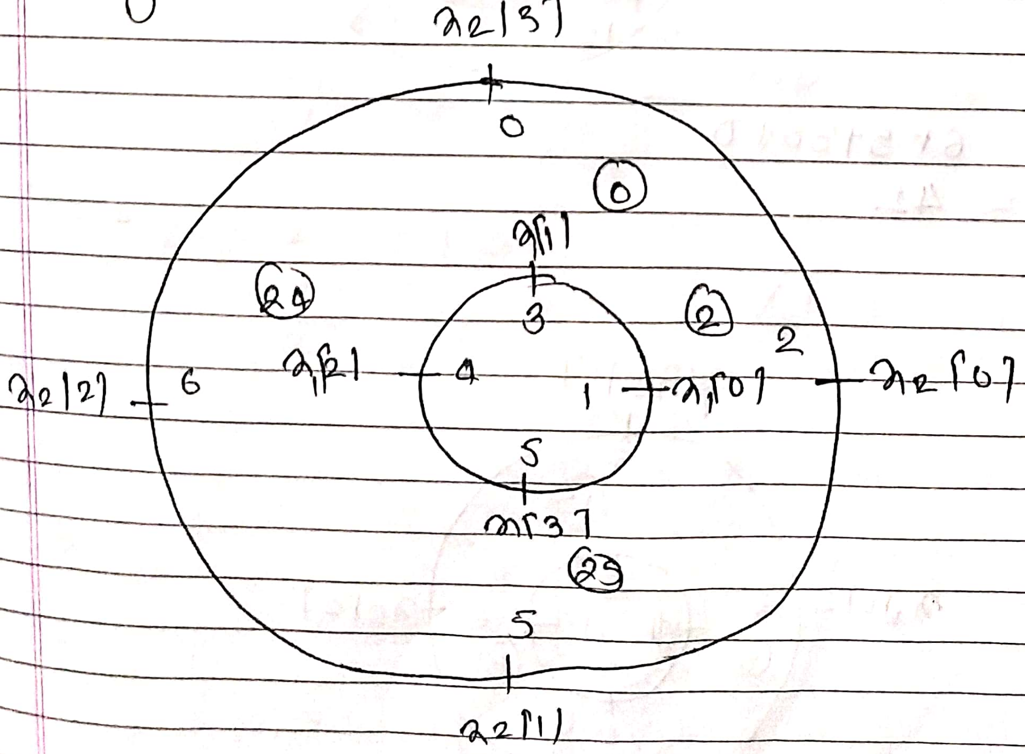
11) $x_1[n] = \{1, 3, 4, 5\}$ and $x_2[n] = \{2, 5, 6, 0\}$.

↓
Not given
so 0.

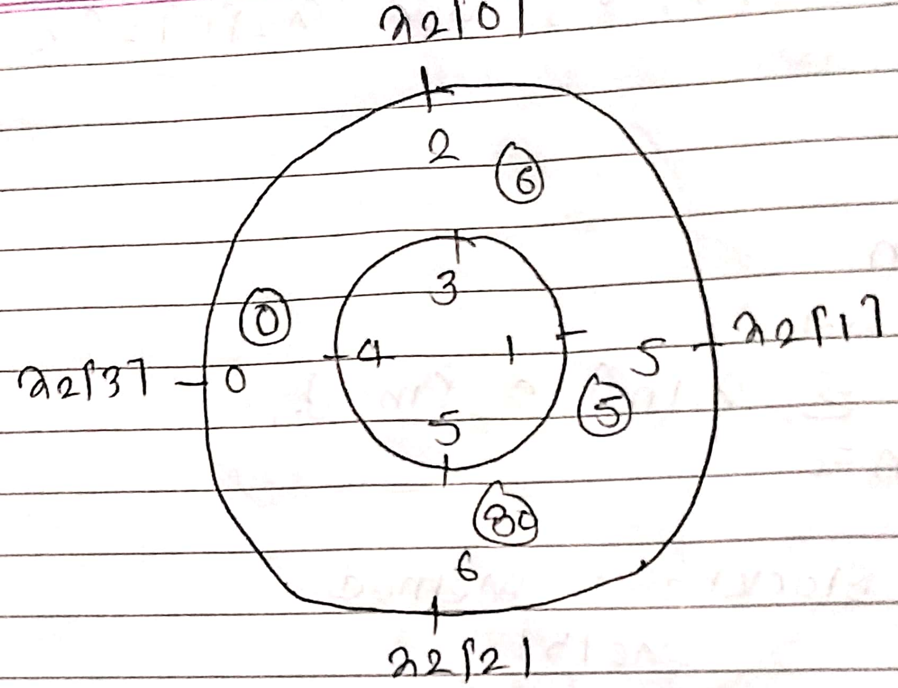
Convolution

$$y[n] = \sum_{n=0}^{N-1} x_1[n] \cdot x_2(m-n)_N.$$

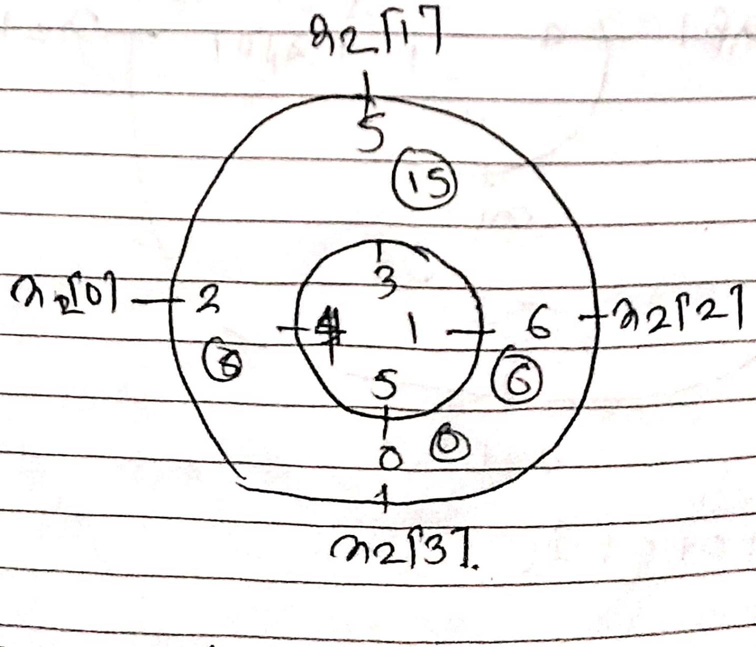
using Stockhams method



$y[0] = 24 + 0 + 2 + 25.$
$= 51.$

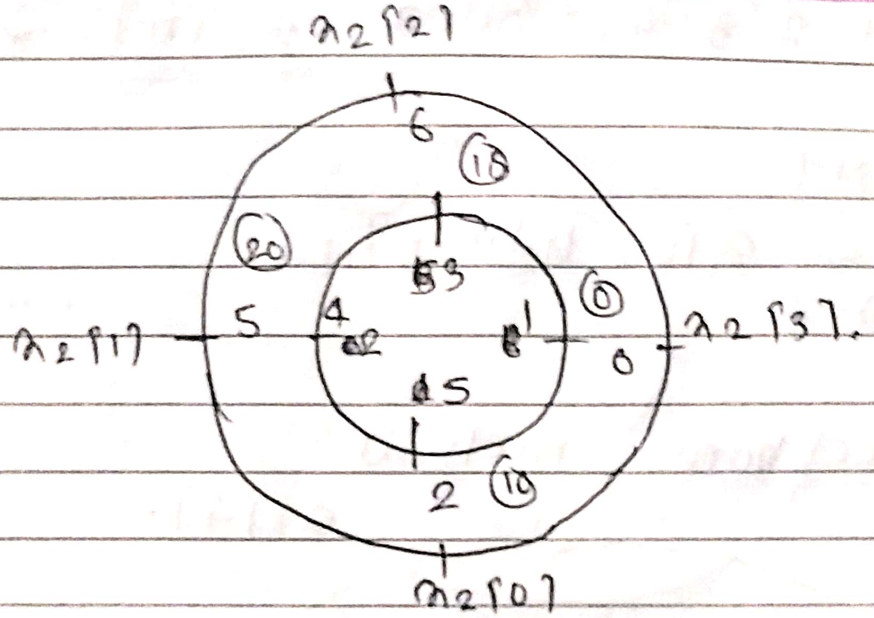


$y[1] = 6+5+30+0$
$= 41.$



$y[2] = 15+6+0+8$
$= 29.$

4



$y[3] = 16 + 0 + 10 + 20$

$= 46$

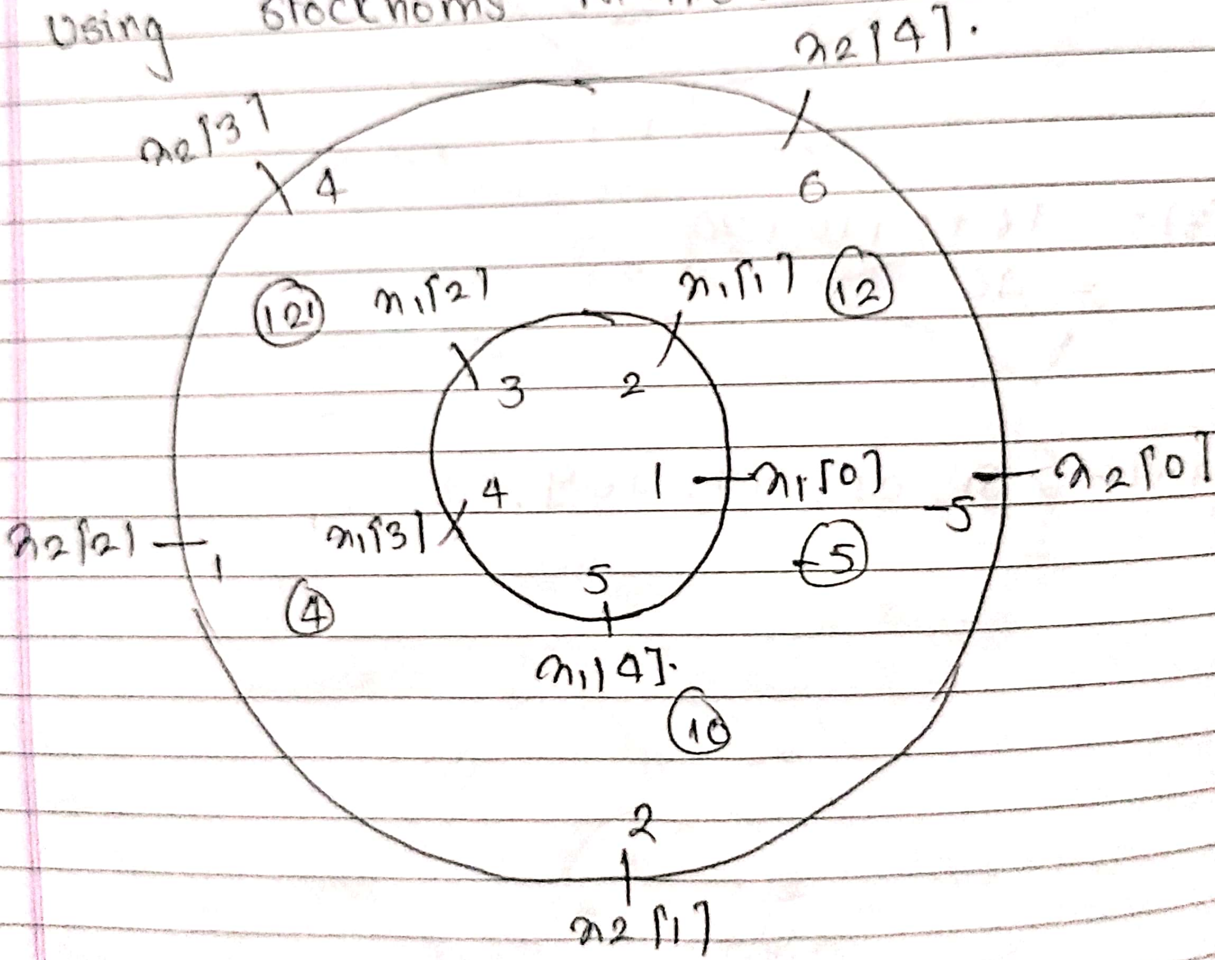
$\therefore y[n] = \{51, 41, 29, 46\}$.

iiii) $x_1[n] = \{1, 2, 3, 4, 5\}$ and $x_2[n] = \{-5, 2, 1, 4, 6\}$

Soln:

$$y[n] = \sum_{m=0}^{N-1} x_1[n]\, x_2[m-n]_N$$

Using Stockhoms method



$y[0] = 12 - 5 + 10 + 4 + 12$
$= 33$

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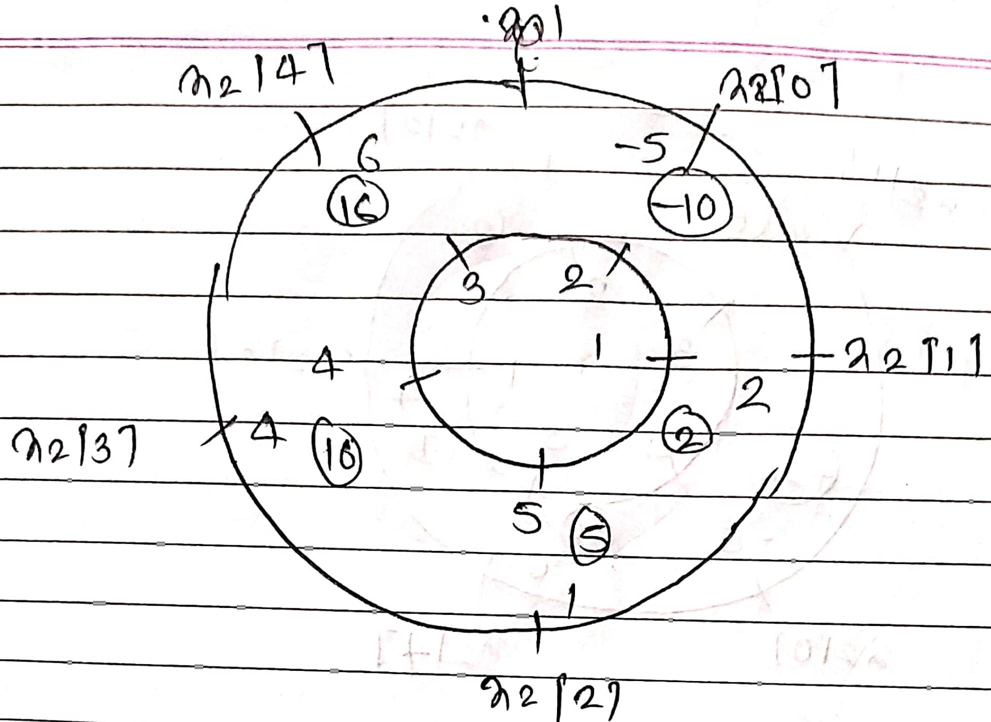
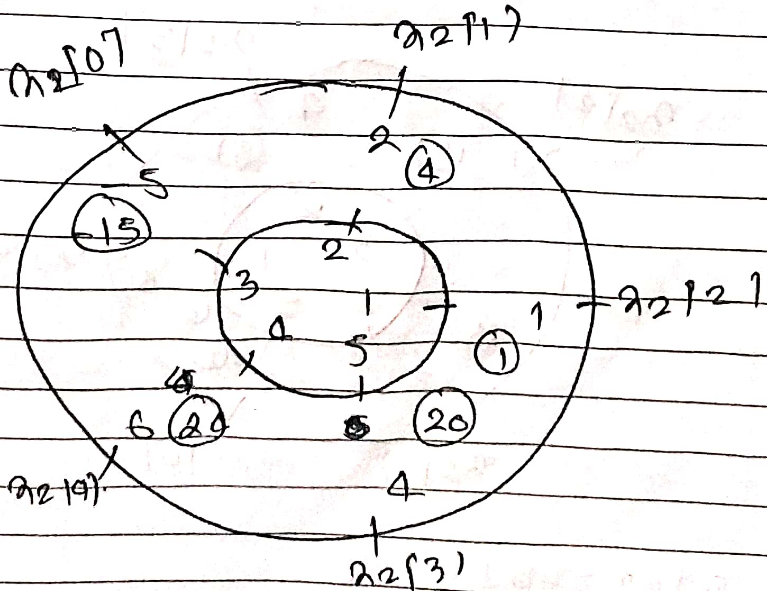
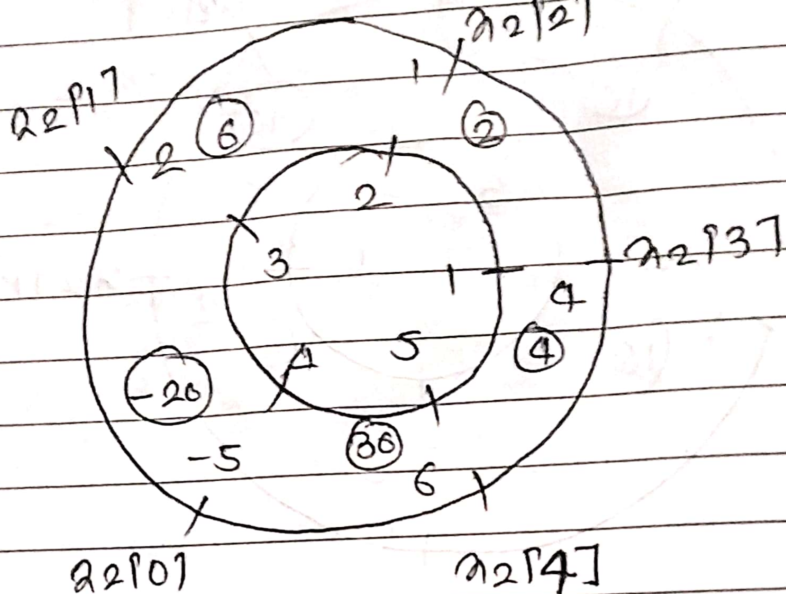


$$y[1] = -10 + 2 + 5 + 16 + 18$$
$$= -3 + 16 + 18$$
$$= 31.$$



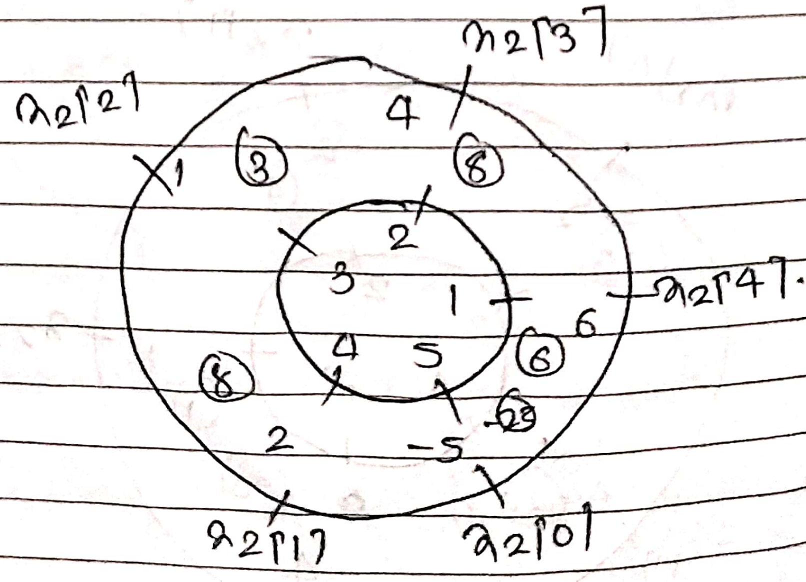
$$y[2] = 4 + 1 + 20 + 24 - 15$$
$$= 10 + 24 = 34.$$



$y[3] = 2+4+30+-20+6.$

$= 6+10+6$

$= 22$



$y[4] = 8+6+-25+8+3$

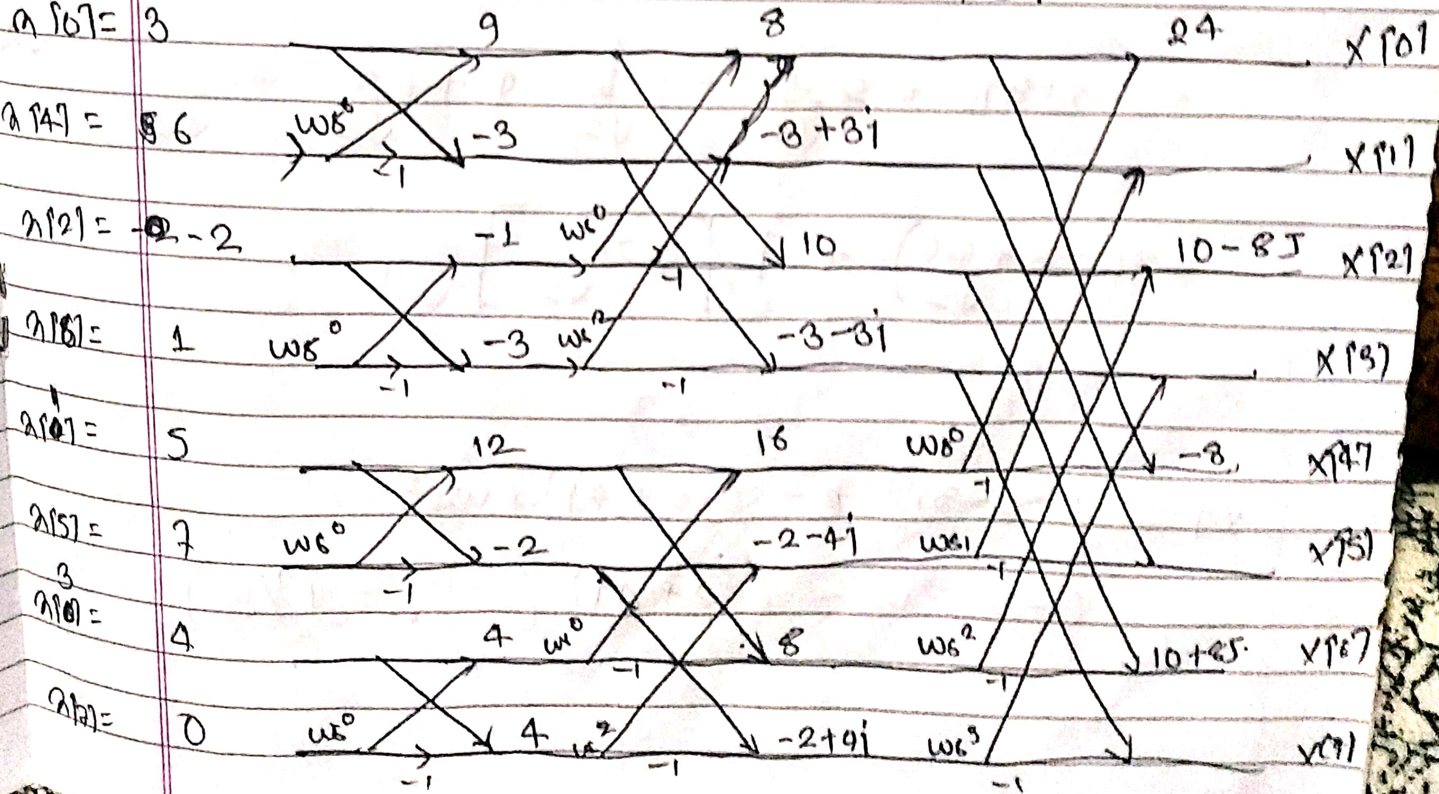
$= 16+9-25 = 0.$

$\therefore y[n] = \{33, 31, 30, 22, 0\}$

Fast Fourier Transform Numericals.

1) Find 8-point DFT of sequences using both DITFFT and DIFFFT Algorithm.

$$\begin{array}{cccccccccc} & & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ a) & x[n] = \{ & 3, & 5, & -2, & 4, & 6, & 7, & 1, & 0\} \end{array}$$



$w_8^0 = 1$

$w_8^1 = 1/\sqrt{2} - i\,1/\sqrt{2}$

$w_8^2 = -i$

$w_8^3 = -1/\sqrt{2} - i\,1/\sqrt{2}$

$$X_1 = (-3+3i) + (-2+4i) \times w_8$$

$$= (-3+3i) + (-2+4i)\left(1/\sqrt{2} - i\,1/\sqrt{2}\right)$$

$$= -3+3i + 2\cdot\frac{1}{\sqrt{2}} + i\cdot\frac{2}{\sqrt{2}} + i\cdot\frac{4}{\sqrt{2}} + \frac{4}{\sqrt{2}}$$

$$= \left(-3 + \frac{6}{\sqrt{2}}\right) + i\left[3 - \frac{2}{\sqrt{2}}\right]$$

$$X_7 = (-3-3i) - (-2+4i) \times w_8^3$$

$$= (-3-3i) - (-2+4i)\left(-1/\sqrt{2} - i\,1/\sqrt{2}\right)$$

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$= (-3-3i) + (-2+4i)\left(1/\sqrt{2} + i\,1/\sqrt{2}\right)$

$= -3-3i + \left(-2/\sqrt{2} - i\,2/\sqrt{2} + \frac{4i}{2} - \frac{4}{\sqrt{2}}\right).$

$= \left(-3 - \frac{6}{\sqrt{2}}\right) - i\,(-i.$

$x_1 = (-3+3i) + (-2 \mp 4i) \times W8$

$= (-3+3i) + (-2 \mp 4i) \times \left(1/\sqrt{2} - \frac{i}{\sqrt{2}}\right).$

$= -3+3i - \frac{2}{\sqrt{2}} + \frac{2i}{\sqrt{2}} \pm \frac{4i}{\sqrt{2}} \mp \frac{4}{\sqrt{2}}$

$= \left(-3 \mp \frac{6}{\sqrt{2}}\right) + i\left(3 \mp \frac{2}{\sqrt{2}}\right).$

$x_7 = (-3-3i) - (-2+4i) \times \left(-1/\sqrt{2} - i/\sqrt{2}\right).$

$= (-3-3i) + (-2+4i)\left(1/\sqrt{2} + \frac{i}{\sqrt{2}}\right)$

$= (-3-3i) + \left[\frac{-2}{\sqrt{2}} - \frac{2i}{\sqrt{2}} + \frac{4i}{\sqrt{2}} - \frac{4}{\sqrt{2}}\right].$

$= \left(-3 - \frac{6}{\sqrt{2}}\right) - i\left(3 - \frac{2}{\sqrt{2}}\right).$

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$$X_3 = (-3-3i) + (-2+4i)\,w_8^3$$

$$= (-3-3i) + (-2+4i)\left(-\frac{1}{\sqrt{2}} - \frac{i}{\sqrt{2}}\right)$$

$$= (-3-3i) + \left[\frac{2}{\sqrt{2}} + \frac{2i}{\sqrt{2}} - \frac{4i}{\sqrt{2}} + \frac{4}{\sqrt{2}}\right]$$

$$= \left(-3 + \frac{6}{\sqrt{2}}\right) - i\left(3 + \frac{2}{\sqrt{2}}\right).$$

$$X_5 = (-3+3i) \cancel{+} - (-2-4i)\left(\frac{1}{\sqrt{2}} - \frac{i}{\sqrt{2}}\right)$$

$$= (-3+3i) - \left[\frac{-2}{\sqrt{2}} + \frac{2}{\sqrt{2}}i - \frac{4i}{\sqrt{2}} - \frac{4}{\sqrt{2}}\right]$$

$$= -3 + 3i + \left[\frac{2}{\sqrt{2}} - \frac{2}{\sqrt{2}}i + \frac{4}{\sqrt{2}}i + \frac{4}{\sqrt{2}}\right].$$

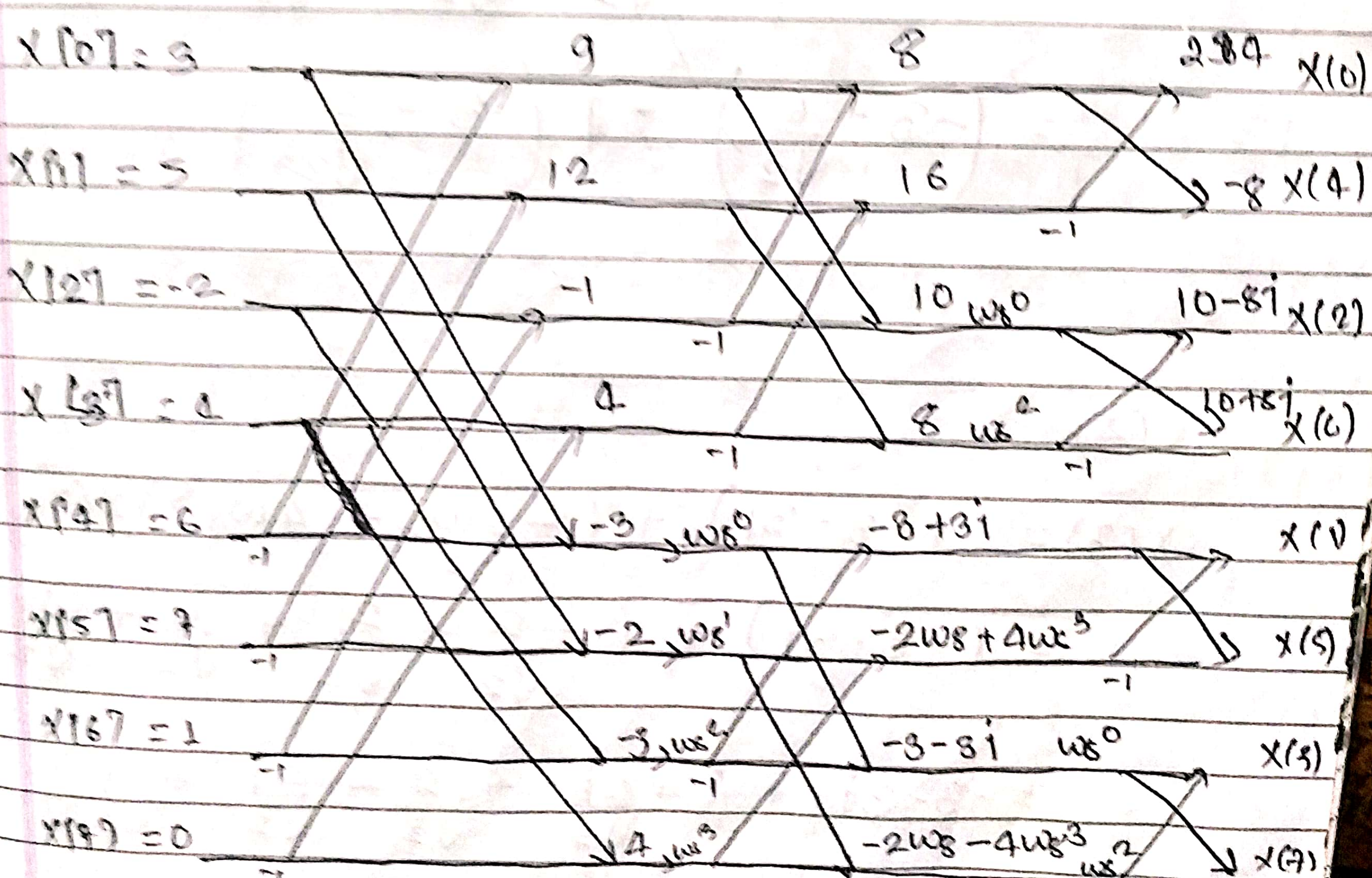
$$= \left(-3 + \frac{6}{\sqrt{2}}\right) + i\left[3 + \frac{2}{\sqrt{2}}\right].$$

(136091981)

Using DIFFFT.

N=8, DIFFFT.

$$W_8 = e^{-j2\pi/8} = 1/\sqrt{2} - j1/\sqrt{2}$$



$$X(1) = -3+3j - 2W_8 + 4W_8^3$$

$$= -3+3j - \frac{2}{\sqrt{2}} + \frac{2j}{\sqrt{2}} + -\frac{4}{\sqrt{2}} - \frac{4j}{\sqrt{2}}$$

$$= \left(-3 - \frac{6}{\sqrt{2}}\right) + j\left(3 \cancel{-} 2\ \frac{2}{\sqrt{2}}\right)$$

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$X(3) = (-3-3i) \cancel{x} + -2w8 - 4w8^3$

$= -3-3i \left(-\frac{2}{\sqrt{2}} + \frac{2i}{\sqrt{2}} + \frac{4}{\sqrt{2}} + \frac{4i}{\sqrt{2}}\right) x - i$

$= -3-3i + \left(+\frac{2i}{\sqrt{2}} + \frac{2}{\sqrt{2}} - \frac{4i}{\sqrt{2}} + \frac{4}{\sqrt{2}}\right.$

$= \left(-3+\frac{6}{\sqrt{2}}\right) - i\left(3 - \frac{2}{\sqrt{2}}\right)$

$\cancel{x(5)} =$

$X(3) = (-3-3i) + (-2w8 - 4w8^3)x(-i)$

$= (-3-3i) + \left(\frac{-2}{\sqrt{2}} + \frac{2i}{\sqrt{2}} + \frac{4}{\sqrt{2}} + \frac{4i}{\sqrt{2}}\right) x - i$

$= -3-3i + \left(+\frac{2i}{\sqrt{2}} + \frac{2}{\sqrt{2}} - \frac{4i}{\sqrt{2}} + \frac{4}{\sqrt{2}}\right)$

$= \left(-3+\frac{6}{\sqrt{2}}\right) - 3i\left(3 + \frac{2}{\sqrt{2}}\right)$

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$X(5) = (-3+3i) + 2w_8 - 4w_8^3$

$= -3+3i + \frac{2}{\sqrt{2}} - \frac{2i}{\sqrt{2}} + \frac{4}{\sqrt{2}} + \frac{4i}{\sqrt{2}}$

$= \left(-3 + \frac{6}{\sqrt{2}}\right) + i\left(3 + \frac{2}{\sqrt{2}}\right)$

$X(7) = (-3-3i) + (2w_8 + 4w_8^3) \times (-i)$

$= -3-3i + \left(\frac{2}{\sqrt{2}} - \frac{2i}{\sqrt{2}} - \frac{4}{\sqrt{2}} - \frac{4i}{\sqrt{2}}\right) \times (-i)]$

$= -3-3i + \left(\frac{-2}{\sqrt{2}} - \frac{2}{\sqrt{2}} + \frac{4i}{\sqrt{2}} - \frac{4}{\sqrt{2}}\right).$

$= \left(-3 - \frac{6}{\sqrt{2}}\right) - i\left(3 - \frac{2}{\sqrt{2}}\right)$

Soln.//

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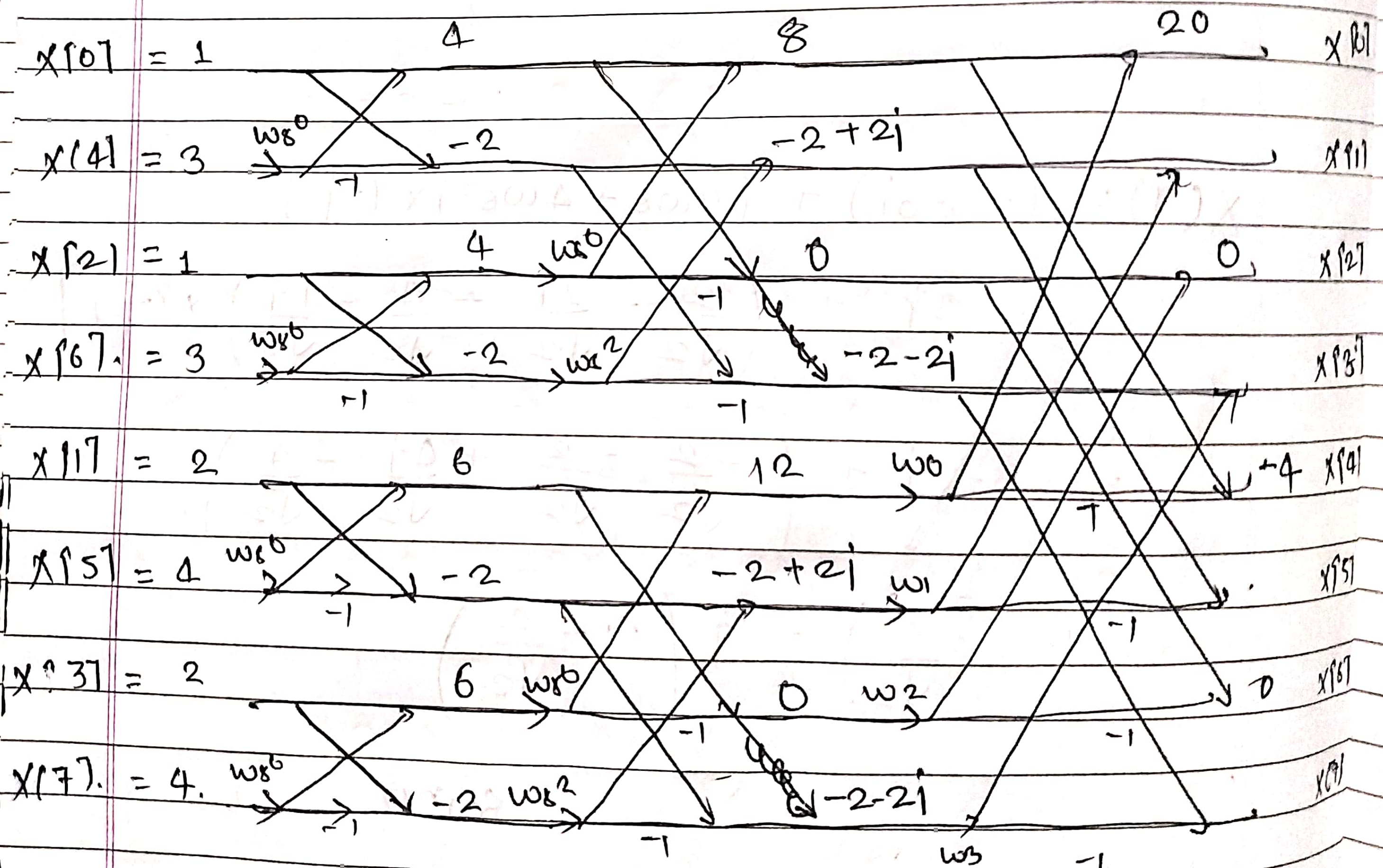
Q. No. 2)

$$\text{i)}\quad x(n) = \{\overset{0}{1}, \overset{1}{2}, \overset{2}{1}, \overset{3}{2}, \overset{4}{3}, \overset{5}{4}, \overset{6}{3}, \overset{7}{4}\}$$

8 point DIF FFT.



$$X(1) = (-2+2j) + (2+2j) \times w_1$$

$$= -2+2j + (2+2j)\left(\frac{1}{\sqrt{2}} - \frac{1}{\sqrt{2}}j\right)$$

$$= -2+2j + \frac{2}{\sqrt{2}} - \frac{2}{\sqrt{2}}j + \frac{2j}{\sqrt{2}} + \frac{2}{\sqrt{2}}$$

$$= \left(-2 + \frac{4}{\sqrt{2}}\right) + i\left(2 - \frac{4}{\sqrt{2}}\right) + 2i$$

$$X(4) = (-2-2i) + (2+2i) \times W_8^3$$

$$= (-2-2i) + (2+2i) \times \left(-1/\sqrt{2} - 1/\sqrt{2}\, i\right)$$

$$= (-2-2i) + -\frac{2}{\sqrt{2}} - \frac{2}{\sqrt{2}} i + \frac{2}{\sqrt{2}} i + \frac{2}{\sqrt{2}}$$

$$= (-2$$

$$X(1) = (-2+2i) + (-2+2i)\left(\frac{1}{\sqrt{2}} - 1/\sqrt{2}\, i\right)$$

$$= -2 + 2i + -\frac{\cancel{2}}{\cancel{\sqrt{2}}} + \cancel{} i + \cancel{} i + \frac{\cancel{2}}{\cancel{\sqrt{2}}} + \frac{4i}{\sqrt{2}}$$

$$= \left(\cancel{-2 + 4/\sqrt{2}}\right) + j\left(2 + 4/\sqrt{2}\right) - 2$$

$$X(7) = (-2-2i) + (2+2i) \times \left(-1/\sqrt{2} - \frac{i}{\sqrt{2}}\right)$$

$$= -2-2i + -\frac{\cancel{2}}{\cancel{\sqrt{2}}} - \frac{2i}{\sqrt{2}} - \frac{2i}{\sqrt{2}} + \frac{\cancel{2}}{\cancel{\sqrt{2}}}$$

$$= -2 - i\left(2 + \frac{4}{\sqrt{2}}\right)$$

$X(3) = (-2-2j) + (-2-2j)\omega^3$

$= -2-2j + (-2-2j)\left(-\frac{1}{\sqrt{2}} - \frac{1}{\sqrt{2}}j\right)$

$= -2-2j + \left(+\frac{2}{\sqrt{2}} + \frac{2}{\sqrt{2}}j + \frac{2}{\sqrt{2}}j - \frac{2}{\sqrt{2}}\right)$

$= -2 - j\left(2 - \frac{4}{\sqrt{2}}\right).$

$X(5) = (-2+2j) - (-2+2j) \times \omega_1$

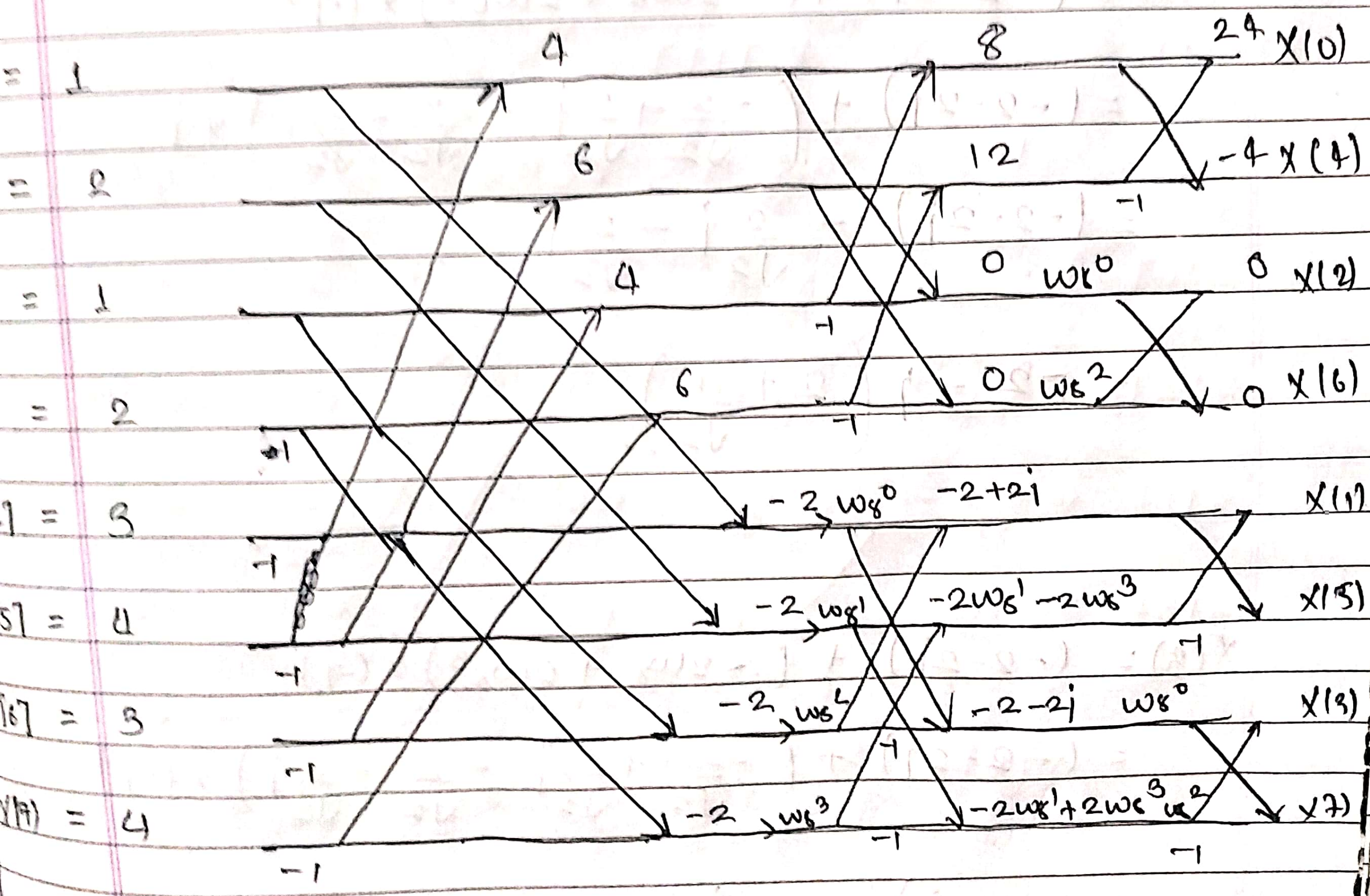
$= (-2+2j) - \left[(-2+2j) \times \left(\frac{1}{\sqrt{2}} - \frac{1}{\sqrt{2}}j\right)\right]$

$= (-2+2j) - \left[-\frac{2}{\sqrt{2}} + \frac{2}{\sqrt{2}}j + \frac{2}{\sqrt{2}}j \; \frac{2}{\sqrt{2}}\right]$

$= -2 + j\left[2 - \frac{4}{\sqrt{2}}\right]$

Ans..

Using DIFFFT.



$$X(1) = -2+2j - 2W_8^1 - 2W_8^3$$

$$= -2+2j - \frac{2}{\sqrt{2}} + \frac{2}{\sqrt{2}}j + \frac{2}{\sqrt{2}} + \frac{2}{\sqrt{2}}j$$

$$= -2 + j\left(2 + \frac{4}{\sqrt{2}}\right).$$

$$X(7) = (-2-2j) - (-2w_8 + 2w_8^3) \times w_8^2$$

$$= (-2-2j) + (-2w_8 + 2w_8^3) \times (-j)$$

$$= (-2-2j) + \left(-\frac{2}{\sqrt{2}} + \cancel{\frac{2}{\sqrt{2}}j} - \frac{2}{\sqrt{2}} - \cancel{\frac{2}{\sqrt{2}}j} \right) \times j$$

$$= (-2-2j) - \frac{2}{\sqrt{2}}j - \frac{2}{\sqrt{2}}j \,)$$

$$= -2 - j\left(2 + \frac{4}{\sqrt{2}}\right).$$

$$X(3) = (-2-2j) + (-2w_8 + 2w_8^3) \times (-j).$$

$$= (-2-2j) + \left(-\frac{2}{\sqrt{2}} + \cancel{\frac{2}{\sqrt{2}}j} - \frac{2}{\sqrt{2}} - \cancel{\frac{2}{\sqrt{2}}j} \right) \times (-j)$$

$$= (-2-2j) + \frac{4}{\sqrt{2}}j$$

$$= -2 - j\left(2 - \frac{4}{\sqrt{2}}\right).$$

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$$X(5) = (-2+2j) + j(2\omega_8 + 2\omega_8^3)$$

$$= -2+2j + \frac{2}{\sqrt{2}} - \frac{2}{\sqrt{2}}j - \frac{2}{\sqrt{2}} - \frac{2}{\sqrt{2}}j$$

$$= -2 + j\left(2 - \frac{4}{\sqrt{2}}\right)$$

$\therefore$ $x(0) = 24$

$x(1) = -2 + j(2 + 4/\sqrt{2})$

$x(2) = 0$

$x(3) = -2 - j(2 - 4/\sqrt{2})$

$x(4) = -4$

$x(5) = -2 + j(2 - 4/\sqrt{2})$

$x(6) = 0$

$x(7) = -2 - j(2 + 4/\sqrt{2})$.

Required Answer //

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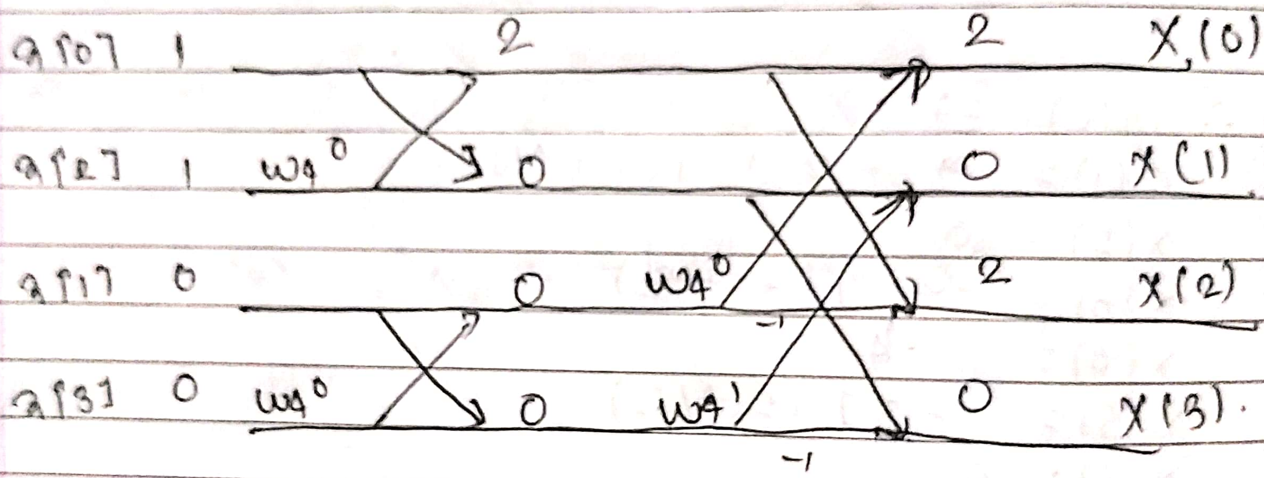
11) Find 4-point DFT of sequences using DITFFT and DIFFFT method

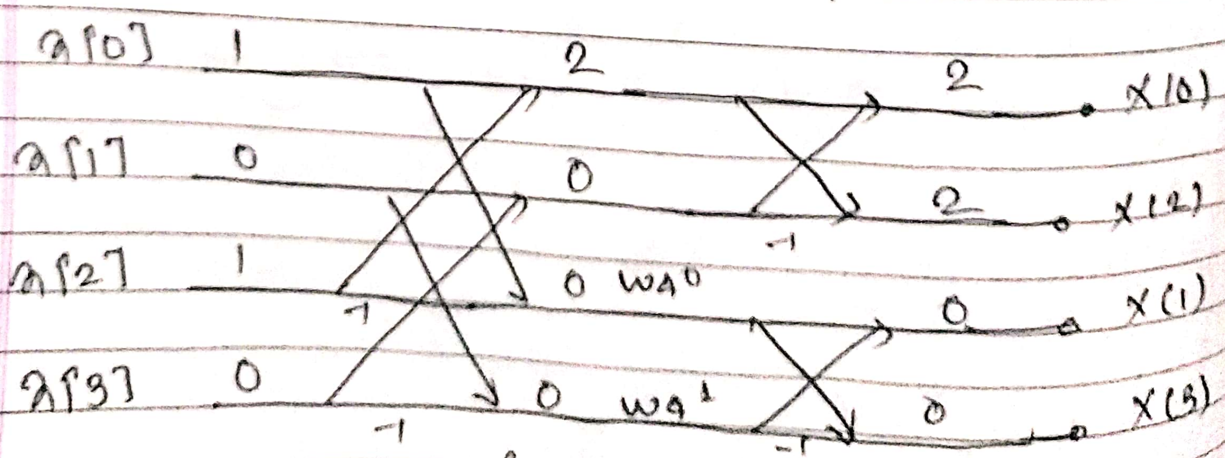
a) N=4, using DITFFT

$x[n] = \cos\frac{\pi}{2}n \quad 0 \le n \le 3 = \{1, 0, 1, 0\}$



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

4 point using DIFFFT, $x[n] = \{1, 0, 1, 0\}$



$\therefore X(k) = \{2, 0, 2, 0\}$ #

Q3) ~~Here~~ find Missing component of 8-point DFT

$X(K) = \{10, -2+J6, -3-J, -4+J, 2 - - - \}$

we have.

$X(0) = 10$

$X(1) = -2+6J$

$X(2) = -3-J.$

$X(3) = -4+J.$

$X(4) = 2$

now,

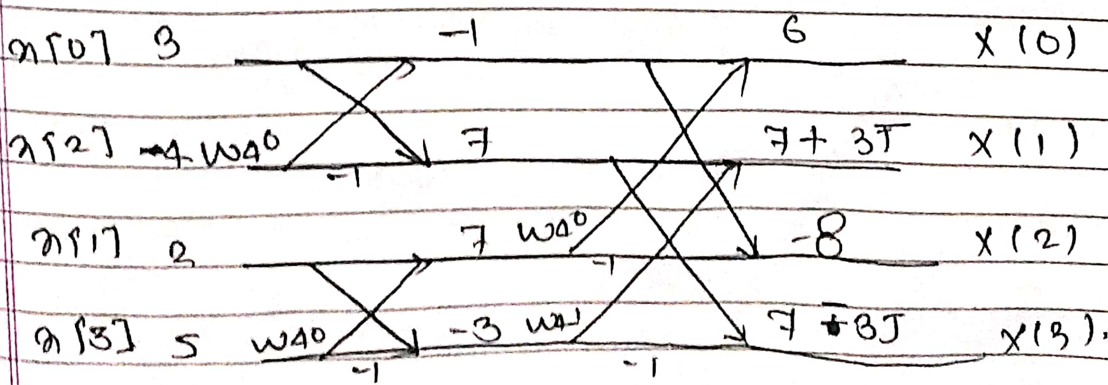
$X(5) =$ Conjugate of $X(3) = -4-J.$

$X(6) =$ conjugate of $X(2) = -3+J$

$X(7) =$ conjugate of $X(1) = -2-6J.$

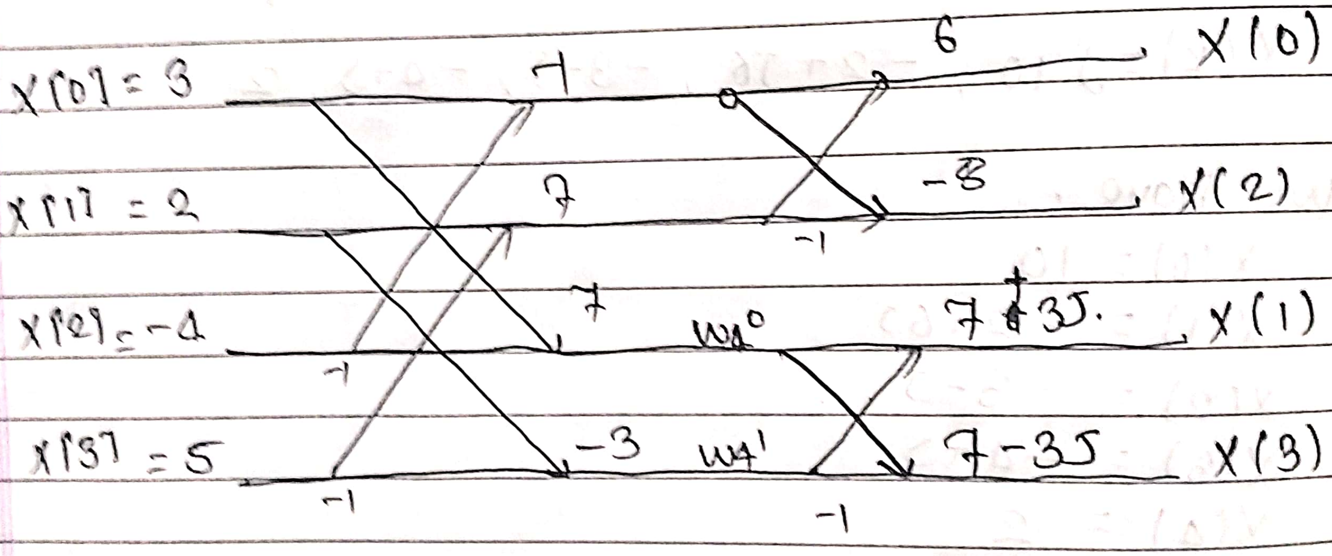
Q.No. 11)

b). $N=4$, DITFFT $x[n] = \{3, 2, -4, 5\}$.



$\therefore X(K) = \{6, 7-3J, -8, 7+3J\}$

$N = 4$, DIFFFT, $x[n] = \{3, 2, -4, 5\}$



$\therefore X(k) = \{6, 7-3j, -8, 7+3j\}$