Planning for ... to

Date Period	Class Subject	Class Work Forecast	Home Work
		Class - B.Tech 2nd yr (E.C.E.)	
		Subject: Signal & System.	
		Faculty: Mandeep Singh	
		Date 9/5/2020	
		Topic: Numerical of Convolution	
Q		Using graphical method obtain a 5-point circular convolutions of two D.T. Signals defined as:	
		$x(n) = (1.5)^n$; $0 \leq n \leq 2$	
		$y(n) = 2n - 3$, $0 \leq n \leq 3$	
		Does the circular convolution obtained is same to that of linear convolution!	
		Given $x(n) = (1.5)^n$;	$0 \leq n \leq 2$

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Class
Subject

For $n=0 \Rightarrow x(0) = (1.5)^0 = 1$

For $n=1 \Rightarrow x(1) = (1.5)^1 = 1.5$

For $n=2 \Rightarrow x(2) = (1.5)^2 = 2.25$

$\therefore x(n) = \{1, 1.5, 2.25\}$

Now $y(n) = 2n-3, \quad 0 \le n \le 3$

For $n=0 \Rightarrow y(0) = 0-3 = -3$

For $n=1 \Rightarrow y(1) = 2-3 = -1.$

For $n=2 \Rightarrow y(2) = 4-3 = 1$

For $n=3 \Rightarrow y(3) = 6-3 = 3.$

$\therefore y(n) = \{-3, -1, 1, 3\}$

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		It is asked to calculate 5-point DFT. That means length of each sequence should be 5. This length is adjusted by adding zero at the end of each sequence as follows (zero padding).	

$$x(n) = \{1, 1.5, 2.25, 0, 0\}.$$

and $y(n) = \{-3, -1, 1, 3, 0\}.$

Now according to the definition of circular convolution

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

here the given sequences are $x(n)$ and $y(n)$ and length $N=5$

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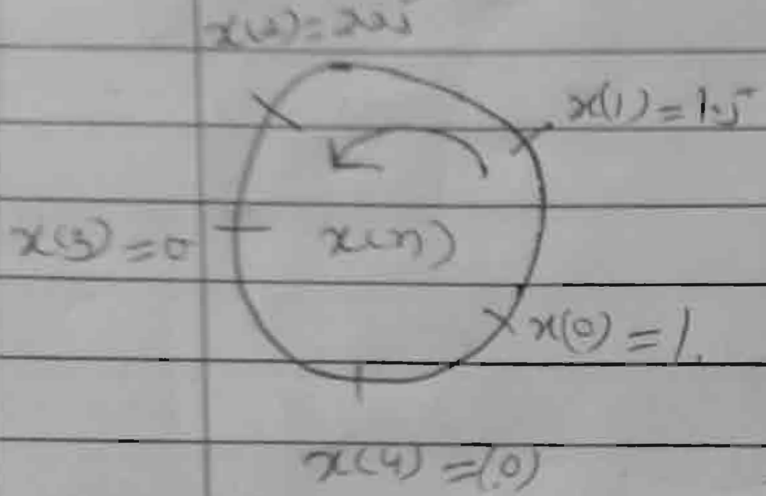
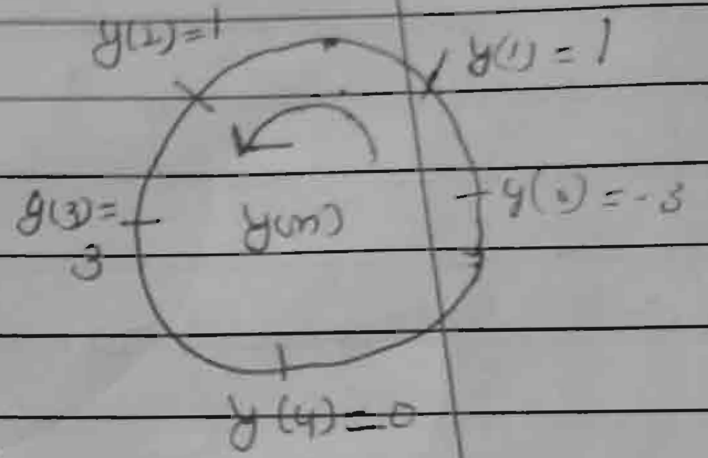
$$\therefore y(m) = \sum_{n=0}^{4} x(n)\, y((m-n))_5 \quad \rightarrow (1)$$

Step 1: Draw x(n) and y(n) as shown





$x(n) = \{1, 1.5, 2.25, 0, 0\}$

$y(n) = \{-3, -1, 1, 3, 0\}$

Fig (a)

Fig b

Now we will obtain values of $y(m)$ by putting $m=0$ to $m=4$ in eq (11)

calculation of $y(0)$

Put $m=0$ in eq (6)

$$y(0) = \sum_{n=0}^{4} x(n) \cdot y((-n))_5 \quad \text{(7)}$$

$$y(0) = \{[1 \times (-3)] + [0 \times (-3)] + [0 \times 1] + [2.25 \times 3] + [1.5 \times 0]\}$$

$$= 3 + 0 + 0 + 6.75 + 0$$

$$\boxed{y(0) = 3.75}$$

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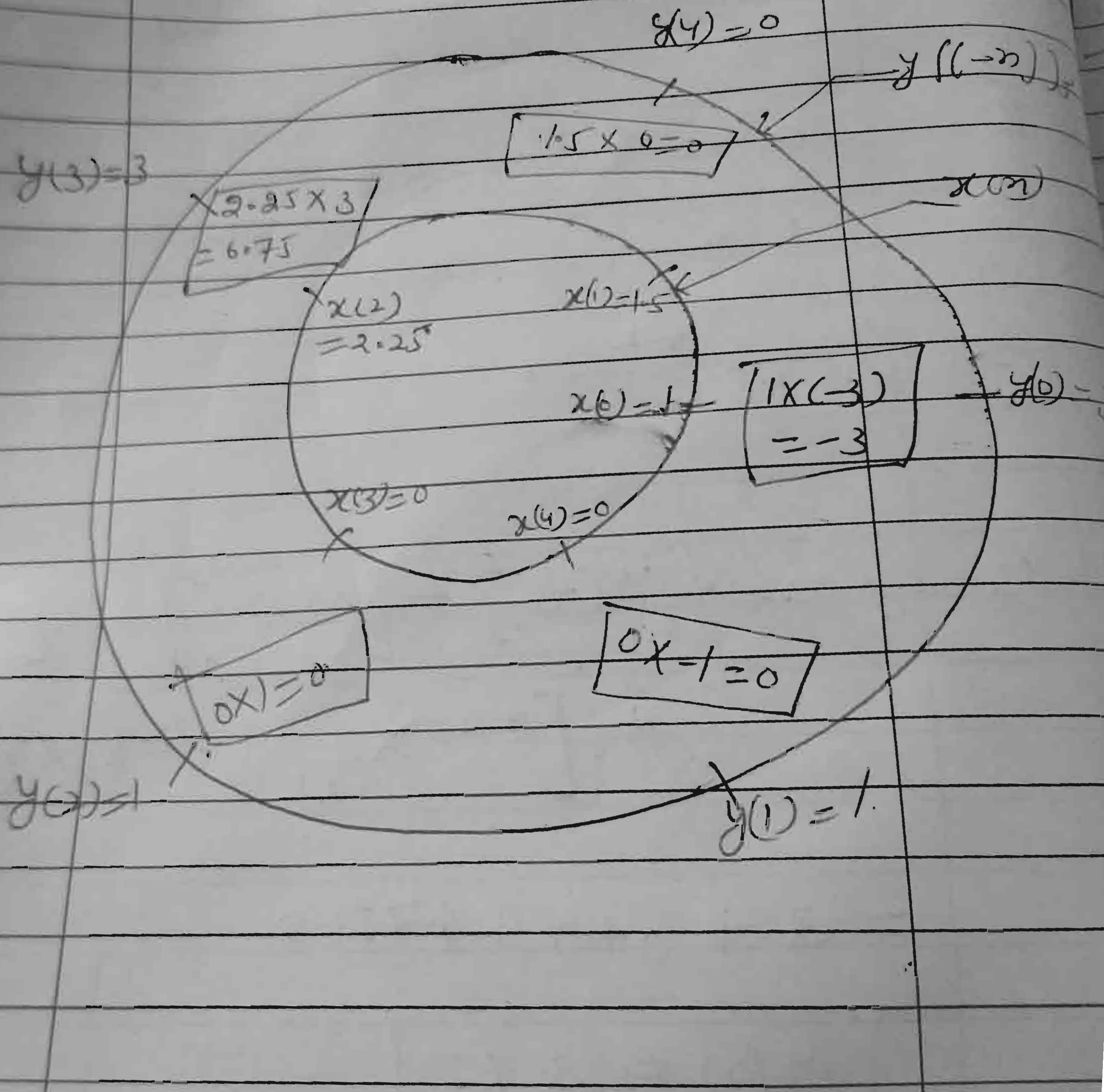
Class Subject	Class Work Forecast	Home Work



Class
Subject

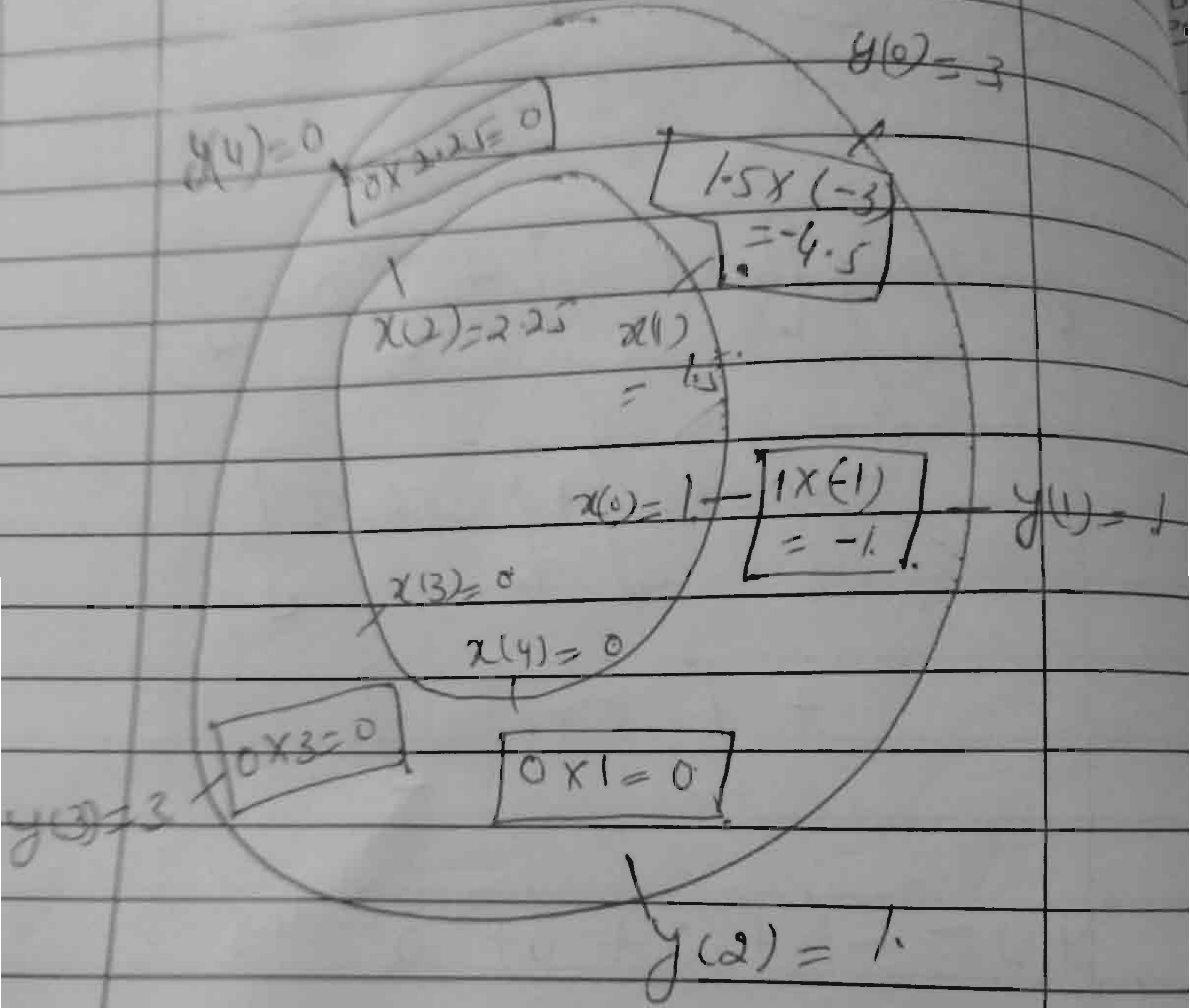
Step III: Putting $m = 1$ in eq. (5)

$$y(1) = \sum_{n=0}^{4} x(n) \cdot y((1-n))_5 .$$

$$\therefore y(1) = \{[1 \times (-1)] + [0 \times 1] + [0 \times 3] + [0 \times 2.25] + [1.5 \times (-3)]$$

$$y(1) = -1 + 0 + 0 + 0 - 4.5$$

$$\boxed{\therefore y(1) = -5.5}$$


y(0) = 3
y(4) = 0
0×2.25 = 0
1.5×(−3) = −4.5
x(2) = 2.25
x(1) = 1.5
x(0) = 1
1×(−1) = −1
y(1) = 1
x(3) = 0
x(4) = 0
0×3 = 0
y(3) = 3
0×1 = 0
y(2) = 1

Class Work Forecast | Home Work

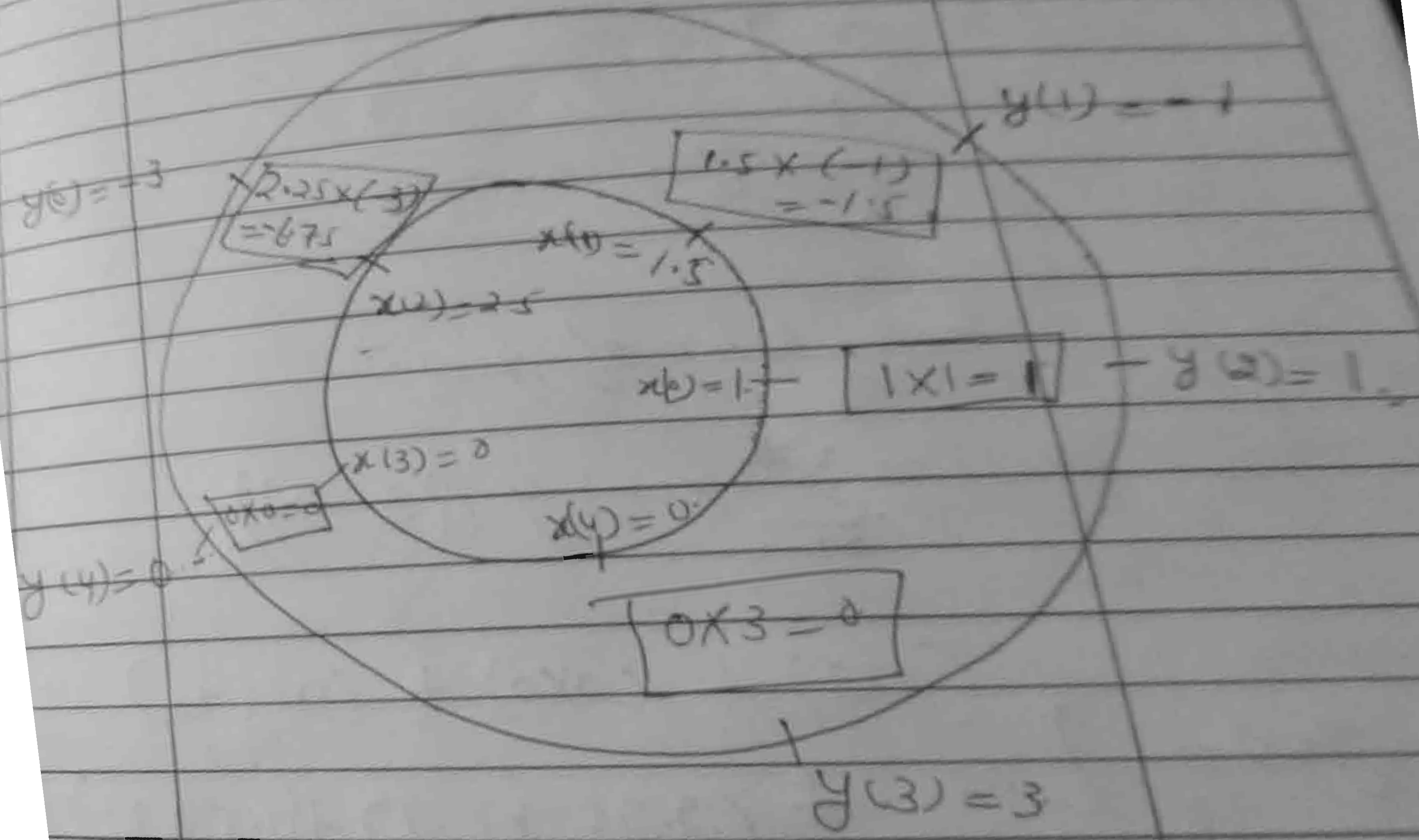
Class Subject

Step-IV:

$n = 2$

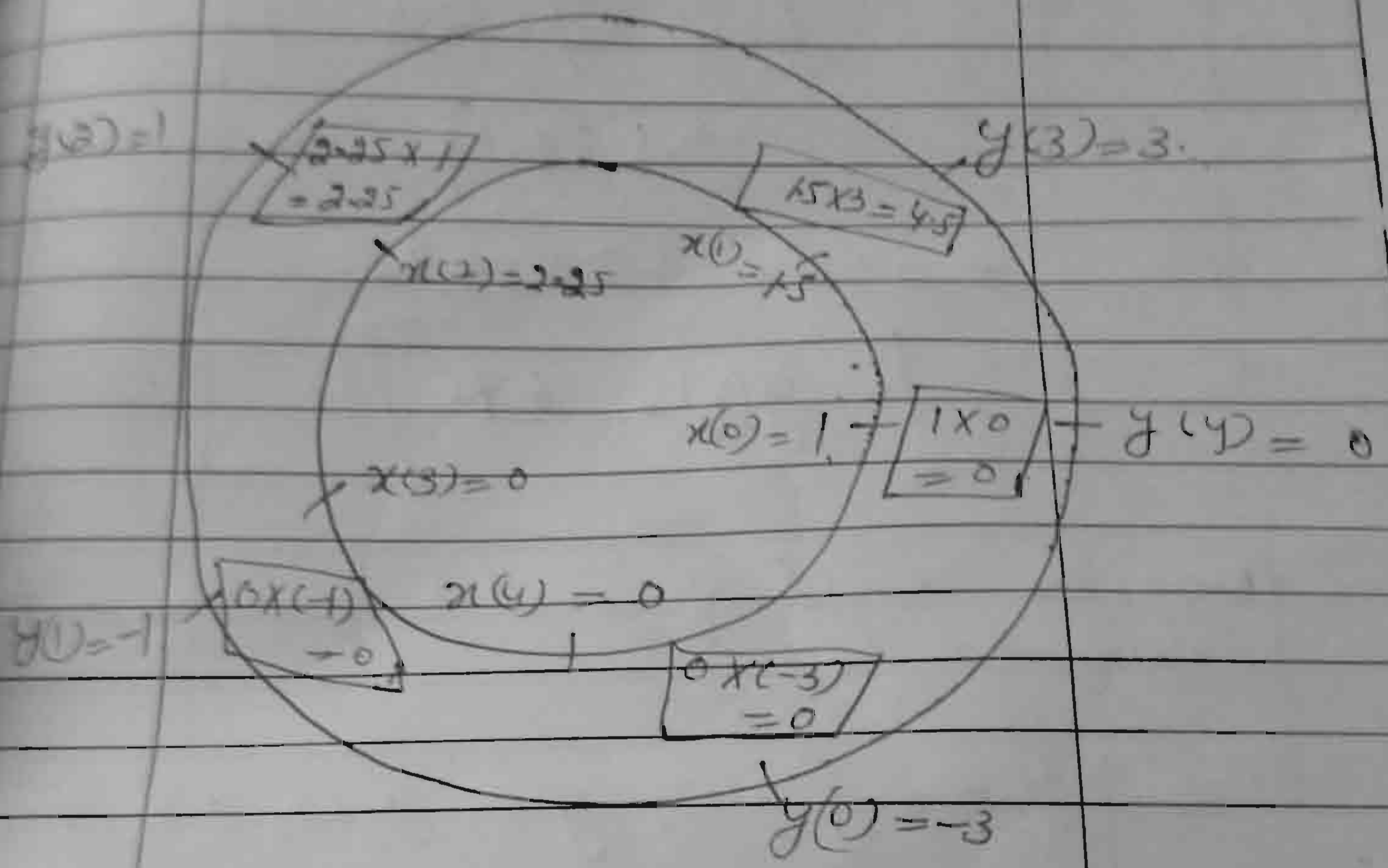
Putting

$$y(2) = \sum_{n=0}^{4} x(n) \cdot y((2-n))_5$$



Day/Period	Subject	
		$\therefore y(2) = \{(1\times 1) + (0\times 3) + (0\times 0) + (2.25\times(-3)) + (1.5\times(-1))\}$
		$= 1 + 0 + 0 - 6.75 - 1.5$
		$\therefore y(2) = -7.25$
Step – V		calculation of $y(3)$:-
		$y(3) = \sum_{n=0}^{4} x(n)\, y((3-n))_5$
$\therefore$	$y(3) =$	$\{(1\times 3) + (0\times 0) + (0\times(-3)) + (2.25\times(-1)) + (1.5\times 1)\}$
		$\therefore y(3) = 2.25$

Remarks : __________



y(2)=1
2.25 x 1
= 2.25
y(3) = 3.
1.5x3 = 4.5
x(2) = 2.25
x(1) = 1.5
x(0) = 1
1x0
= 0
y(4) = 0
x(3) = 0
x(4) = 0
0x(-1)
= 0
y(1)=-1
0x(-3)
= 0
y(0) = -3

Planning for

Class Work Forecast

Days Period	Class Subject		Home Work

$$\therefore y(4) = \{(1\times 0) + (0\times(-3)) + (0\times(-1)) + (2.25\times 1) + (1.5\times 3)\}$$

$$= 0+0+0+2.25+4.5$$

$$\therefore y(4) = 6.75$$

Now the result of circular convolution can be expressed as:

$$y(n) = \{y(0), y(1), y(2), y(3), y(4)\}$$

$$\therefore y(n) = \{3.75, -5.5, -7.25, 2.25, 6.75\}$$

Class Work Forecast

Comparision with linear Convolution.

$x(n) = \{1, 1.5, 2.25\}$

$= \{1, 1.5, 2.25, 0\}$

and $y(n) = \{-3, -1, 1, 3\}$

Let $y_1(n) = x(n) * y(n)$.

The linear convolution of $x(n)$ and $y(n)$ is shown

	1 ⇐ $y_1(0)$	1.5 ⇐ $y_1(1)$	2.25 ⇐ $y_1(2)$	0 ⇐ $y_1(3)$
-3	-3	-4.5	-6.75	0 ⇐ $y_1(3)$
				⇐ $y_1(4)$
-1	-1	-1.5	-2.25	0
1	1	1.5	2.25	0 ⇐ $y_1(5)$
3	3	4.5	6.75	0 ⇐ $y_1(6)$

Period | Subject

$y_1(0) = -3$

$y_1(1) = -1 - 4.5 = -5.5$

$y_1(2) = 1 - 1.5 - 6.75 = -7.25$

$y_1(3) = 3 + 1.5 - 2.25 = 2.25$

$y_1(4) = 4.5 + 2.25 = 6.75$

$y_1(5) = 6.75 + 0 = 6.75$

$y_1(6) = 0$

Thus $x(n) * y(n) = \{-3, -5.5, -7.25, 2.25, 6.75, 0\}$

Note: Circular convolutions and linear convolutions are not same

Remarks :

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