Circular convolution and CC using DFT

Experiment No: 6

Aim

- (a) Circular Convolution of discrete time sequences with built-in function using MATLAB
- (b) Circular Convolution of discrete time sequences without built-in function using MATLAB
- (c) Circular Convolution of discrete time sequences using DFT

Circular Convolution

- Find the circular convolution of $x(n)=\{2,3\}$, $h(n)=\{1,2,2,3\}$

Zero padding $x(n)=\{2,3,\ 0,0\}$

Procedure:

1. Graph points in the circle in counter clockwise direction
2. Multiply corresponding samples on the two circle and sum the products
3. Rotate one sample at a time in counterclockwise direction

Circular Convolution

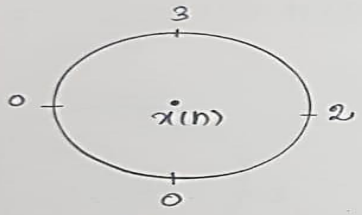
Circular Convolution :-

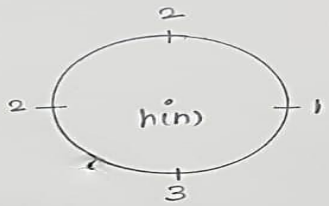
$x(n) = \{2, 3\}$ $\quad h(n) = \{1, 2, 2, 3\}$

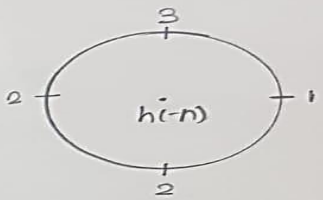
Now,

$x(n) = \{2, 3, 0, 0\}$.

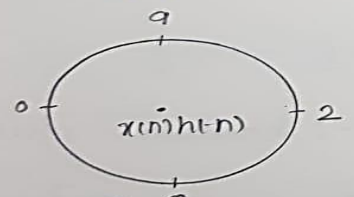
$$y(n) = \sum_{n=0}^{3} x(n)\, h((m-n))_N$$







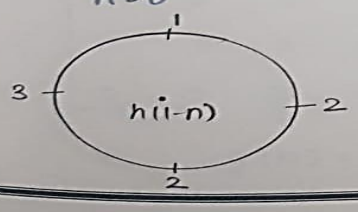
$$y(0) = \sum_{n=0}^{3} x(n)\, h((-n))_4$$

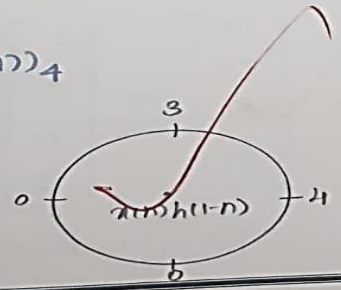


$= 2+9$

$y(0) = 11.$

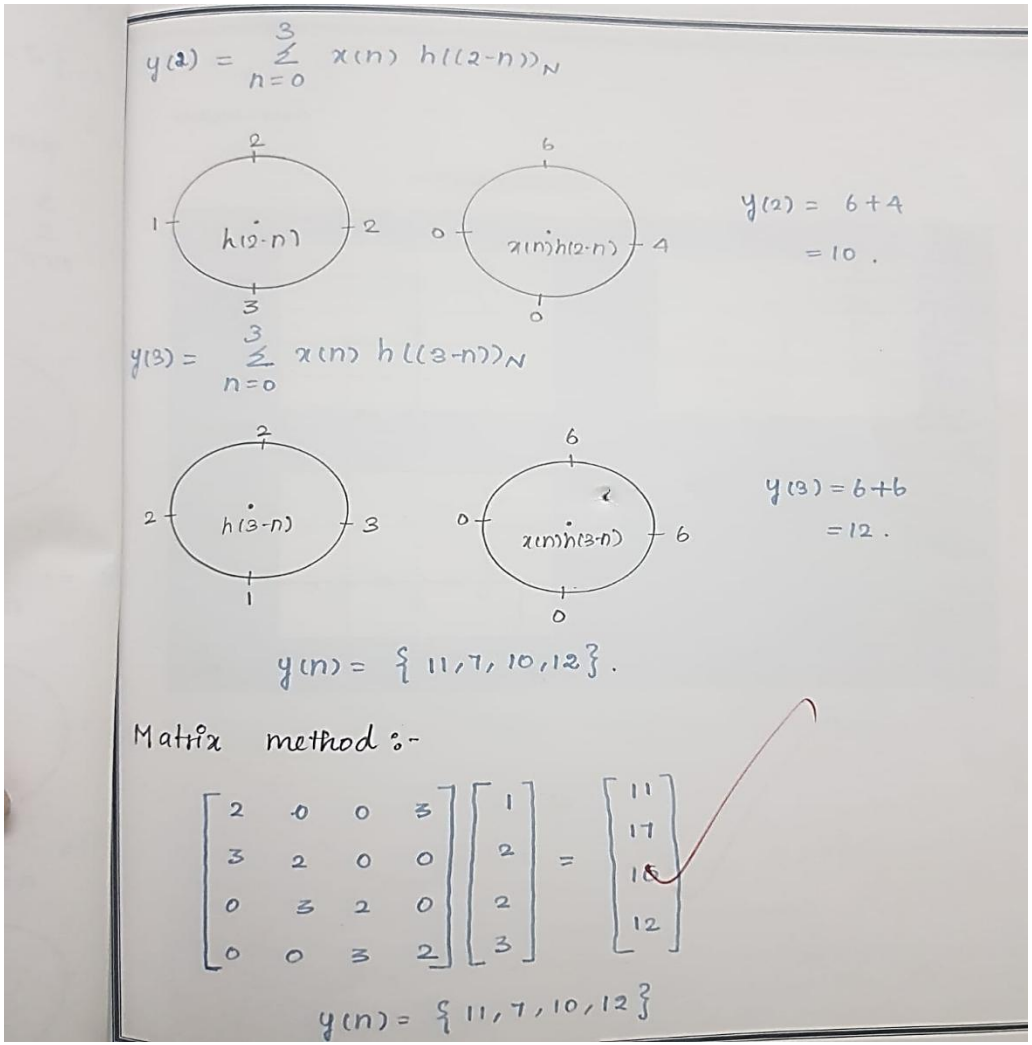
$$y(1) = \sum_{n=0}^{3} x(n)\, h((1-n))_4$$





$y(1) = 3+4 = 7$

Circular Convolution



- **Circular Convolution of discrete time sequences using DFT**

Given $x(n)=\{1,2,1,2\}$, $h(n)=\{1,2,3,4\}$

$DFT\{x(n)\}=\{6,0,-2,0\}$

$DFT\{h(n)\}=\{10,-2+j2,-2,-2-j2\}$

Convolution of two sequence in time domain is equal to multiplication of their transforms in frequency domain → convolution property

$y(n)=x(n)*h(n)$ → in time domain

$Y(k)=X(k)H(k)$ → in frequency domain

$Y(k)=\{60,0,4,0\}$

Take inverse transform , $y(n)=IDFT\{Y(k)\}=\{16,14,16,14\}$

```
65      %circular conv by dft
66 -    x=[1 2 1 2]
67 -    h=[1 2 3 4]
68 -    xf=fft(x)
69 -    hf=fft(h)
70 -    yf=xf.*hf
71 -    y=ifft(yf)
72
```

Command Window

```
yf =

    60     0     4     0


y =

    16    14    16    14
```