LINEAR CONVOLUTION AND CIRCULAR CONVOLUTION USING DFT AND IDFT

LINEAR CONVOLUTION

MATLAB CODE:

```
%linear convolution using DFT and IDFT

x=input('Enter the seq x[n]');
h=input('Enter the seq h[n]');
l1=length(x);
l2=length(h);

N=l1+l2-1; %length of linearly convolved output

%calculate N point DFT seq
X=fft(x,N);
H=fft(h,N);

Y=X.*H;
y=round(ifft(Y))

%plots
n1=0:l1-1;
subplot(2,2,1);
stem(n1,x);
xlabel('n');
ylabel('x[n]');
title("i/p signal");

n2=0:l2-1;
subplot(2,2,2);
stem(n2,h);
xlabel('n');
ylabel('h[n]');
title("impulse signal");

n3=0:length(y)-1;
subplot(2,2,[3,4]);
stem(n3,y);
xlabel('n');
ylabel('y[n]');
title("output signal");
```

TEST CASE:

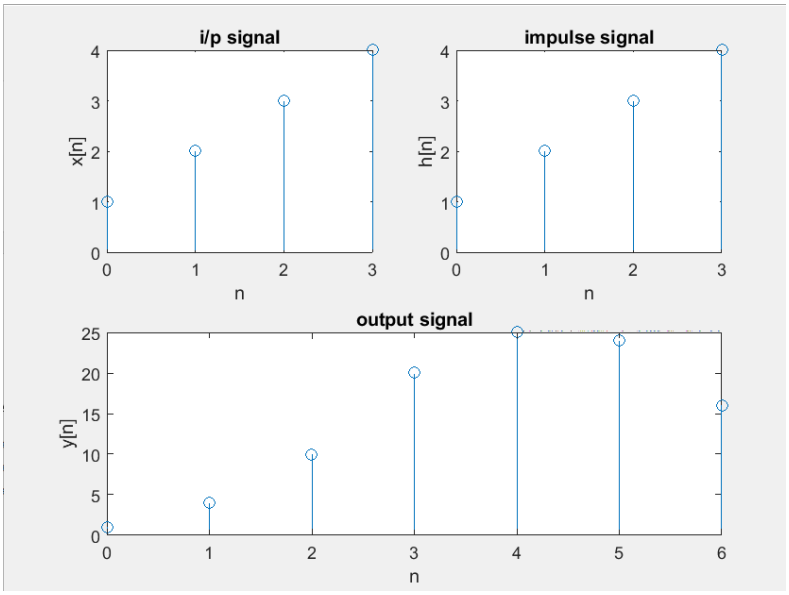
X[n]=[1 2 3 4]

H[n]=[1 2 3 4]

TERMINAL OUTPUT:

```
>> exp4linear
Enter the seq x[n][1 2 3 4]
Enter the seq h[n][1 2 3 4]

y =

     1     4    10    20    25    24    16
```

PLOT:



2.CIRCULAR CONVOLUTION

MATLAB CODE

```
%circular convolution using DFT and IDFT

x=input('Enter the seq x[n]');
h=input('Enter the seq h[n]');
l1=length(x);
l2=length(h);

N=max(l1,l2); %  Number of zeros to be padded for shorter sequence.

%calculate N point DFT seq
X=fft(x,N);
H=fft(h,N);

Y=X.*H;
y=round(ifft(Y))

%plots
n1=0:l1-1;
subplot(2,2,1);
```

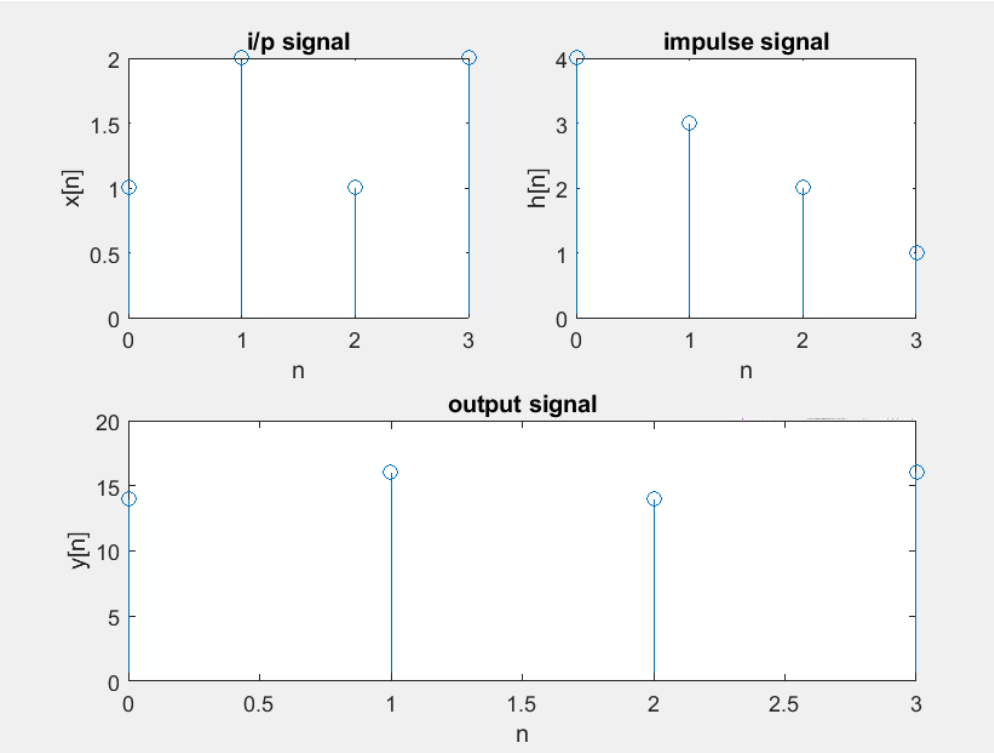
```
stem(n1,x);
xlabel('n');
ylabel('x[n]');
title("i/p signal");

n2=0:l2-1;
subplot(2,2,2);
stem(n2,h);
xlabel('n');
ylabel('h[n]');
title("impulse signal");

n3=0:length(y)-1;
subplot(2,2,[3,4]);
stem(n3,y);
xlabel('n');
ylabel('y[n]');
title("output signal");
```

TEST CASE:
h[n]= [4 3 2 1]
X[n]= [1 2 1 2]

TERMINAL OUTPUT:

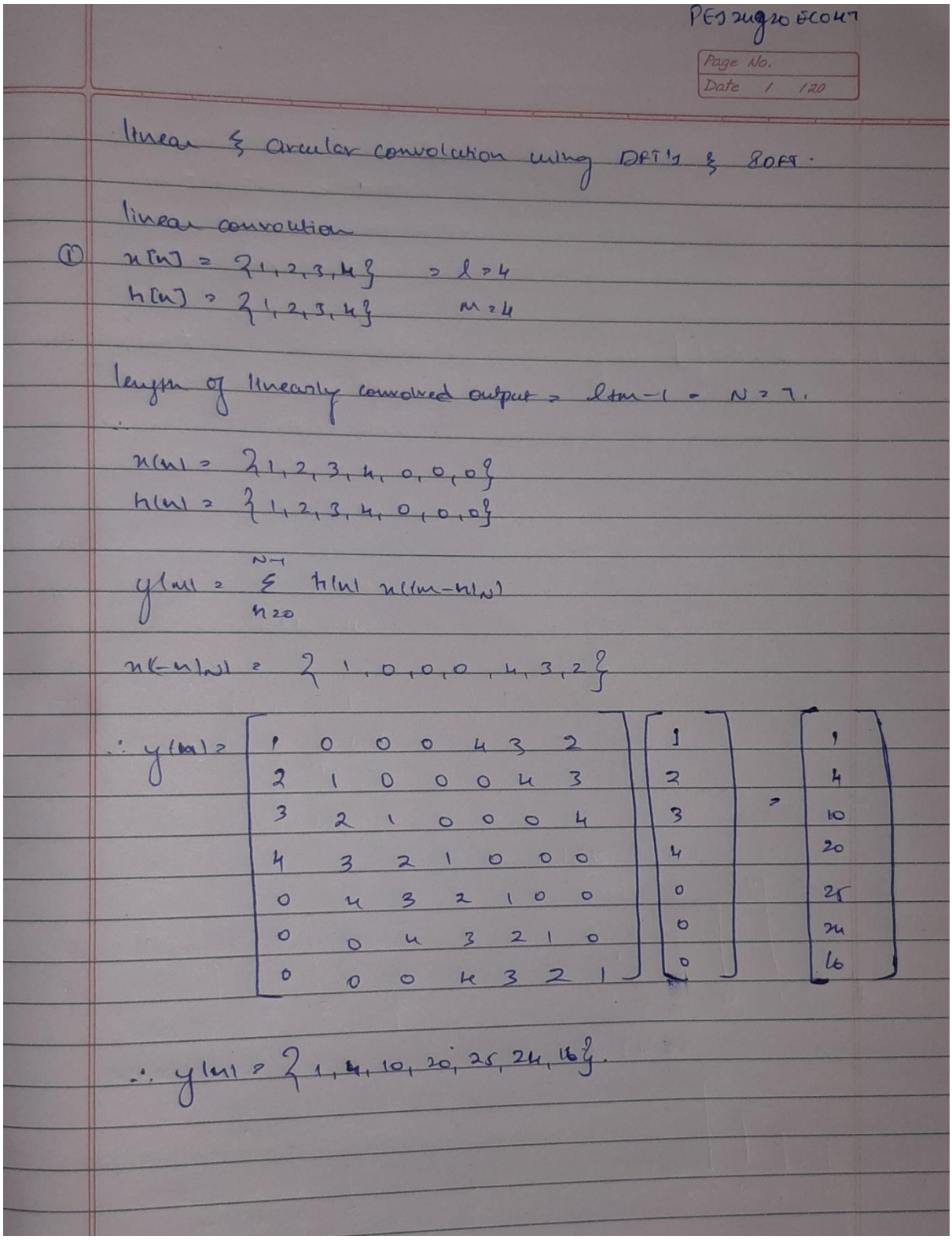
```
>> exp4circular
Enter the seq x[n][1 2 1 2]
Enter the seq h[n][4 3 2 1]

y =

    14    16    14    16
```

PLOT:



THEORETICAL CALCULATIONS:

1.LINEAR CONVOLUTION



PES2UG20EC047

Page No.
Date / /20

Linear & Circular convolution using DFT's & IDFT.

linear convolution

① $x[n] = \{1,2,3,4\} \Rightarrow l = 4$

$h[n] = \{1,2,3,4\} \quad M = 4$

length of linearly convolved output = $l+m-1 = N = 7$.

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

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

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

$x((-n))_7 = \{1,0,0,0,4,3,2\}$

$$\therefore y(n) = \begin{bmatrix} 1 & 0 & 0 & 0 & 4 & 3 & 2 \\ 2 & 1 & 0 & 0 & 0 & 4 & 3 \\ 3 & 2 & 1 & 0 & 0 & 0 & 4 \\ 4 & 3 & 2 & 1 & 0 & 0 & 0 \\ 0 & 4 & 3 & 2 & 1 & 0 & 0 \\ 0 & 0 & 4 & 3 & 2 & 1 & 0 \\ 0 & 0 & 0 & 4 & 3 & 2 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 0 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} 1 \\ 4 \\ 10 \\ 20 \\ 25 \\ 24 \\ 16 \end{bmatrix}$$

$\therefore y(n) = \{1,4,10,20,25,24,16\}$.

2.CIRCULAR CONVOLUTION

PE39HU20EC047.

Circular Convolution

$x_1(n) = \{1, 2, 1, 2\}$

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

$$y(n) = \sum_{k=0}^{3} x_1(k)\, h((n-k))_4$$

$y(0) = x_1(0)\, h((-0))_4 + x_1(1)\, h((-1))_4 + x_1(2)\, h((-2))_4 + x_1(3)\, h((-3))_4$

$= 4 + 2 + 2 + 6$

$= 14$

$y(1) = x_1(0)\, h(1) + x_1(1)\, h(0) + x_1(2)\, h(3) + x_1(3)\, h(2)$

$= 3 + 8 + 1 + 4$

$= 16$

$y(2) = x_1(0)\, h(2) + x_1(1)\, h(1) + x_1(2)\, h(0) + x_1(3)\, h(3)$

$= 2 + 6 + 4 + 2$

$= 14$

$y(3) = x_1(0)\, h(3) + x_1(1)\, h(2) + x_1(2) \cdot h(1) + x_1(3) \cdot h(0)$

$= 1 + 4 + 3 + 8$

$= 16$

$\therefore y(n) = \{14, 16, 14, 16\}$