Independent University Bangladesh

Department of Electrical and Electronics Engineering

Lab Report 08

Name: Injamamul Haque Sourov

Id: 1820170

Course code: EEE 321L

Couse name: Digital Signal Processing Lab

Lab no: 07

Lab title: Study on DTFT, Circular Folding and Circular Convolution

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1) Discrete Fourier Transform function definition (dft.m):

```
% function to perform discrete Fourier transform
function [Xk] = dft(xn, N)
n = 0:N-1;
k = 0:N-1;
WN = exp(-j*2*pi/N);
nk = n'*k;
WNnk = WN.^nk;
Xk = xn*WNnk;
end
```

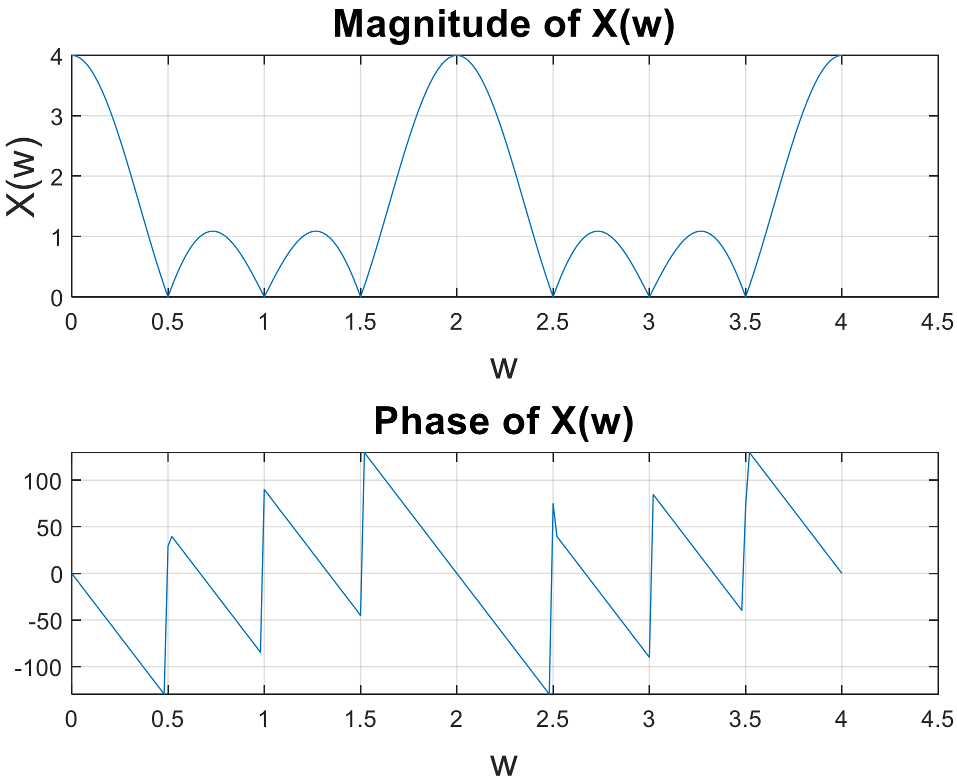
2) DTFT and 4 point DFT of x(n) = [1 1 1 1]

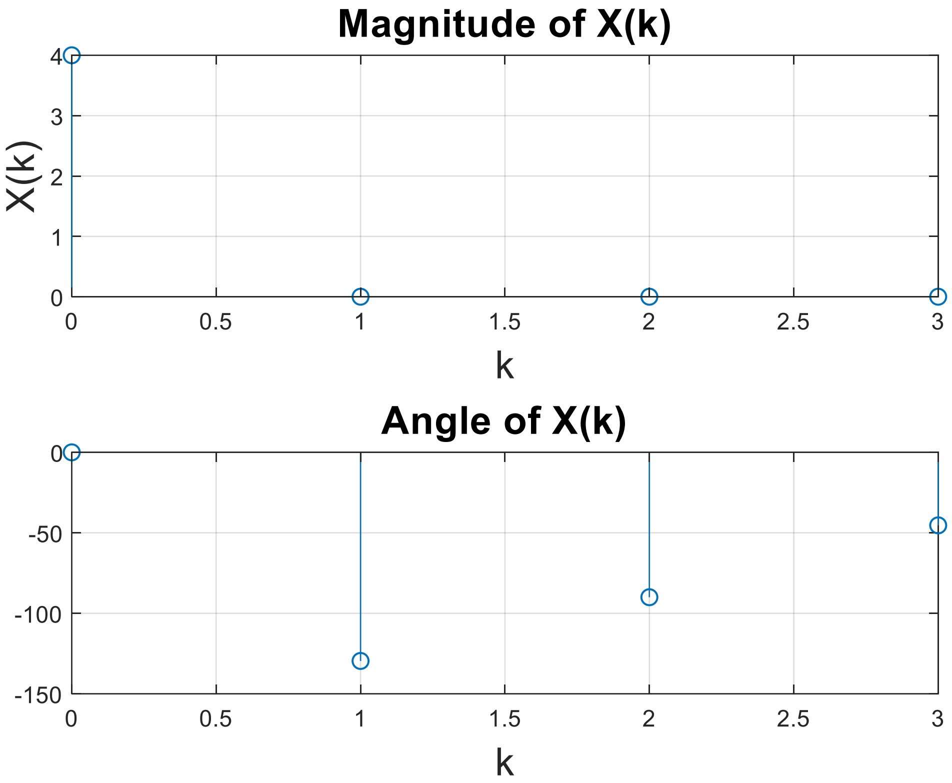
Code:

```
% signal definition
n1 = 0;
n2 = 3;
n = n1:n2;
x = [1 1 1 1];

% parameters for DTFT
M = 200;    % number of frequency points (0,π)
k = 0:M;
w = (4*pi/M)*k;

% parameters for 4 point DFT
N = 4;
m = 0:N-1;
xn = [1 1 1 1];

% compute DTFT
X = x*exp(-j*n'*w);
magX = abs(X);
phX = angle(X);

% compute DFT
Xk = dft(xn, N);
magXk = abs(Xk);
phaXk = angle(Xk)*180/pi;

% Plotting
figure(1);  % for DTFT
subplot(2,1,1);
plot(w/pi,magX)
title('Magnitude of X(w)', 'fontsize', 15);
xlabel('w', 'fontsize', 15);
ylabel('X(w)', 'fontsize', 15);
grid;
subplot(2,1,2);
plot(w/pi,PhaX);
title('Phase of X(w)', 'fontsize', 15);
xlabel('w', 'fontsize', 15);
```

```
grid;

figure(2);  % for DFT
subplot(2,1,1);
stem(m,magXk)
title('Magnitude of X(k)', 'fontsize', 15);
xlabel('k', 'fontsize', 15);
ylabel('X(k)', 'fontsize', 15);
grid;
subplot(2,1,2);
stem(m,phaXk)
title('Angle of X(k)', 'fontsize', 15);
xlabel('k', 'fontsize', 15);
grid;
```

Outputs:





3) Function definition of circular folding (circfold.m):

```
% function to compute N point circular folding
function x2 = circfold(x1, N)
n = 0:N-1;
x2 = x1(mod(-n, N)+1);
end
```

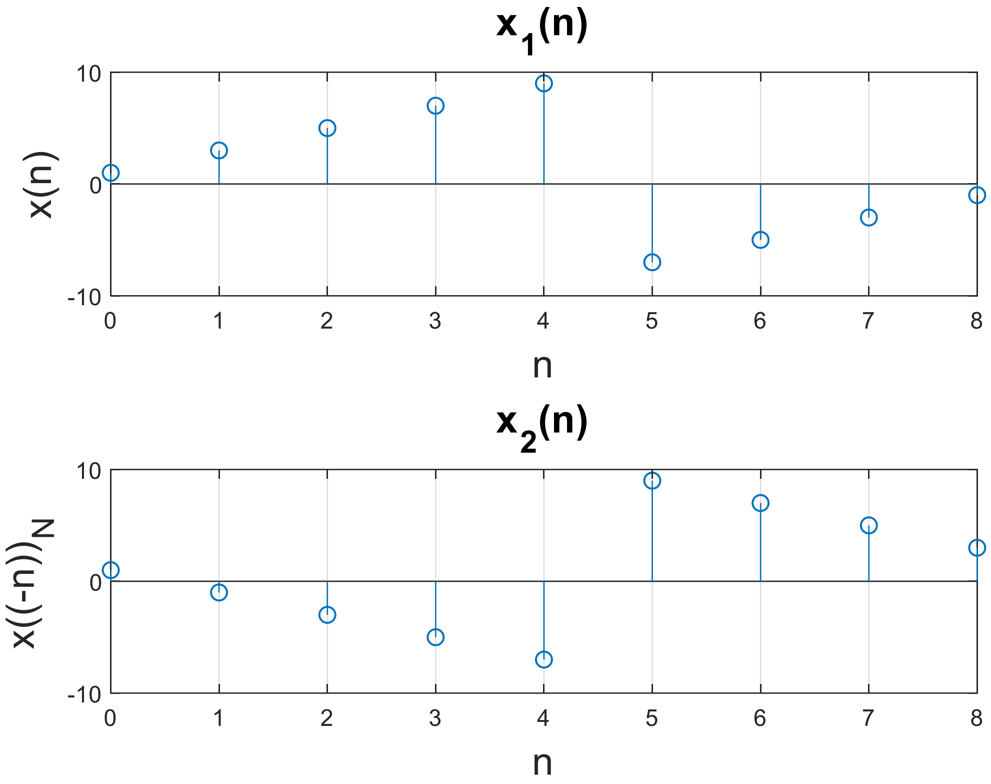
4) Circular folding of x(n) = {1,3,5,7,9,-7,-5,-3,-1}

Code:

```
% circular folding
x1 = [1 3 5 7 9 -7 -5 -3 -1];
N = length(x1);
x2 = circfold(x1, N);
% ploting
subplot(2,1,1);
stem(0:N-1, x1)
title('x_1(n)', 'fontsize', 15);
xlabel('n', 'fontsize', 15);
ylabel('x(n)', 'fontsize', 15);
grid;
subplot(2,1,2);
stem(0:N-1, x2)
title('x_2(n)', 'fontsize', 15);
xlabel('n', 'fontsize', 15);
```

```
ylabel('x((-n))_N', 'fontsize', 15);
grid;
```

Outputs:

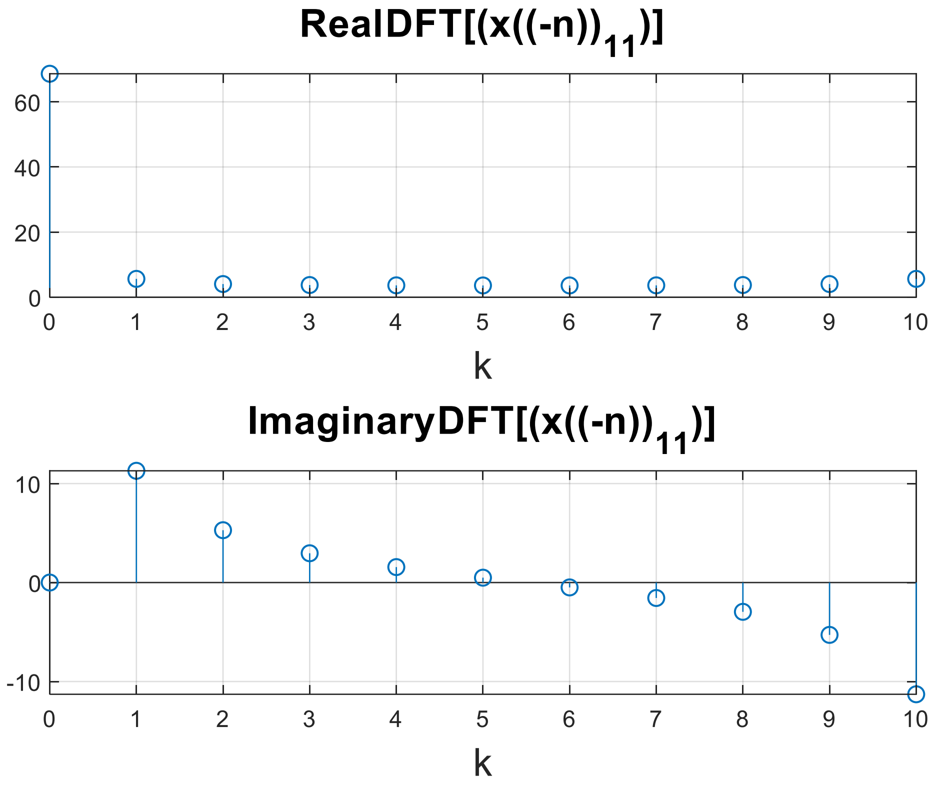


5) 11 point circular folding of x(n) = 10(0.9) n , 0 <= n <= 10

Code:

```
n = 0:10;
x = 10*(0.9).^n;
% circular folding
y = circfold(x, 11);
% DFT
Y = dft(y,11);
% Plotting
subplot(2,1,1);
stem(n, real(Y))
title('Real{DFT[(x((-n))_1_1)]}', 'fontsize', 15);
xlabel('k', 'fontsize', 15);
grid;
subplot(2,1,2);
stem(n, imag(Y))
title('Imaginary{DFT[(x((-n))_1_1)]}', 'fontsize', 15);
xlabel('k', 'fontsize', 15);
grid;
```

Outputs:



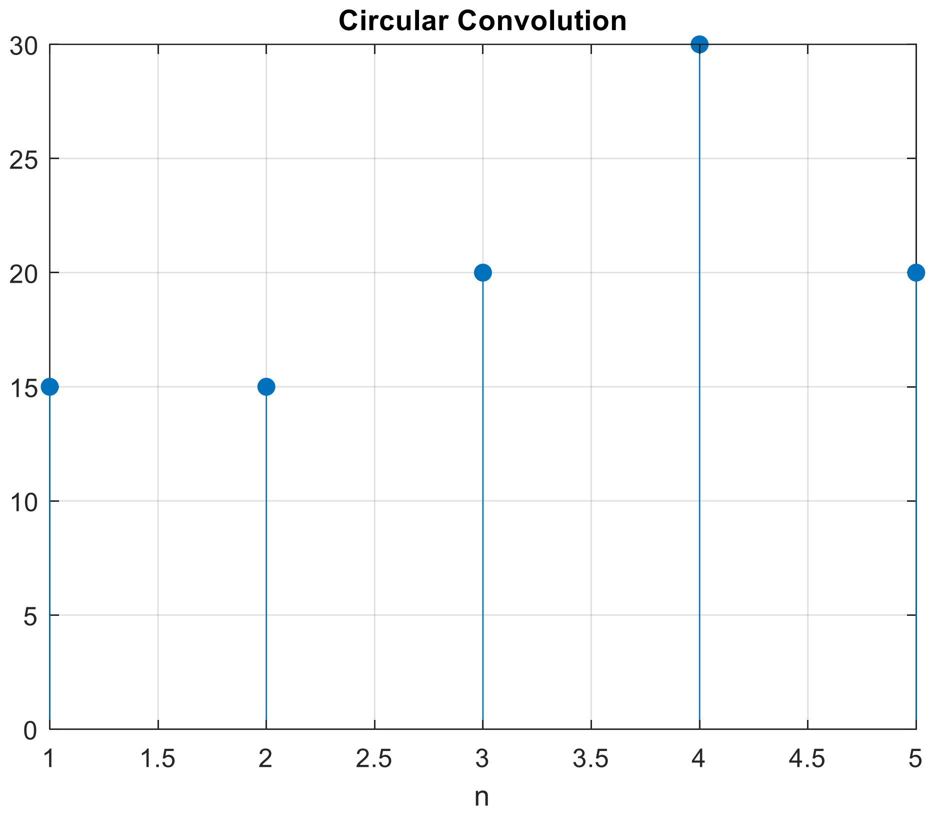
6) Assignment: Circular convolution

    a. Function definition:

```
% function to compute N-point circular convolution of two signals
function [] = circ_conv( x1,x2,N )
% padd signals with 0 to make N points each
x1pad = [x1 zeros(1,N-length(x1))];
x2pad = [x2 zeros(1,N-length(x2))];
% conv in t domain = multiplication in f domain
cconv = ifft(fft(x1pad).*fft(x2pad));
y = cconv;
% plot
stem(y)
title('Circular Convolution')
xlabel('n')
grid on
end
```

Call and output:

```
% arbitrary signals
x1 = [1 2 3 4];
x2 = [4 3 2 1];
% 5 point circular conv
circ_conv(x1,x2,5)
```


Circular Convolution
n