DSP Lab_1 Report

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M1

Analysis

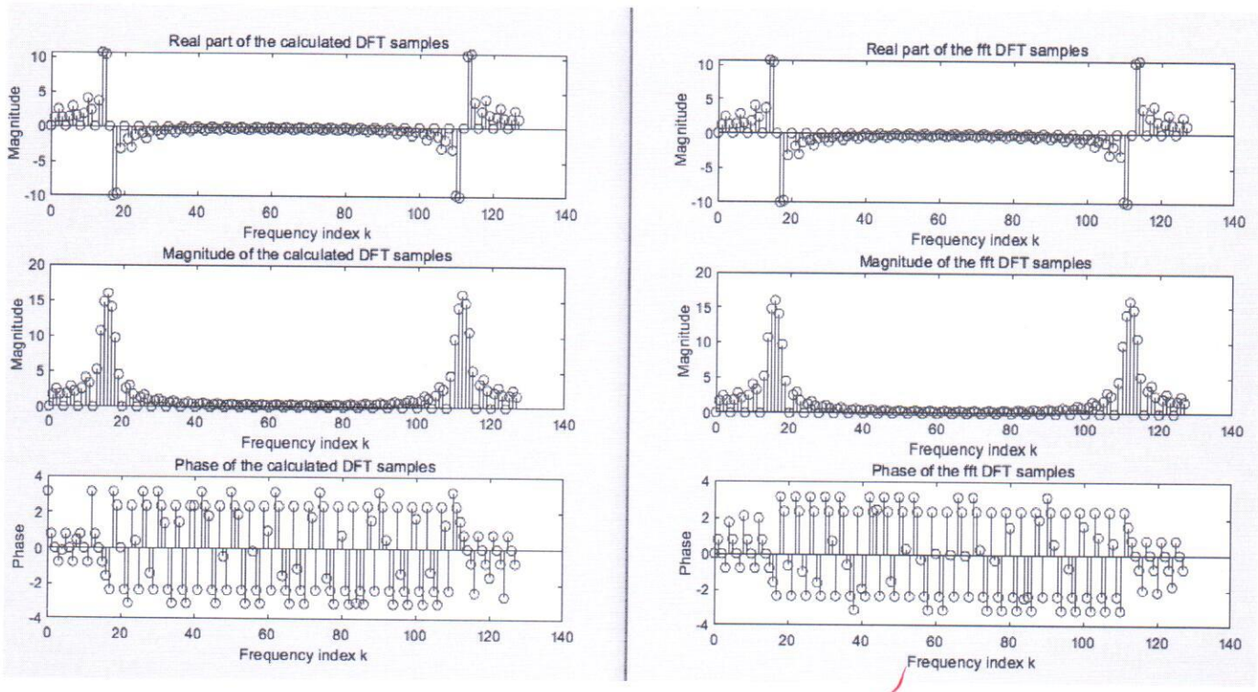
This experiment aims to calculate DFT of a time-domain sequence.

MATLAB Codes

```
clc;
n = 0:1:31;
M = 128;
u = [sin((pi*n)/4) zeros(1,96)];
U = fft(u,M);
a = zeros(1,M);
b = zeros(1,M);
c = zeros(1,M);
for k = 0:M-1
    for n1 = 0:M-1
        a(k+1) = a(k+1) + u(n1+1)*cos(2*pi*k*n1/M)
        b(k+1) = b(k+1) + u(n1+1)*sin(2*pi*k*n1/M)
    end
    c(k+1) = a(k+1)-1j*b(k+1)
end
k = 0:1:M-1;
figure(1)
subplot(3,1,1)
stem(k,real(c))
title('Real part of the calculated DFT samples')
xlabel('Frequency index k'); ylabel('Magnitude')
subplot(3,1,2)
stem(k,abs(c))
title('Magnitude of the calculated DFT samples')
xlabel('Frequency index k'); ylabel('Magnitude')
subplot(3,1,3)
stem(k,angle(c))
title('Phase of the calculated DFT samples')
xlabel('Frequency index k'); ylabel('Phase')

figure(2)
subplot(3,1,1)
stem(k,real(U))
title('Real part of the fft DFT samples')
xlabel('Frequency index k'); ylabel('Magnitude')
subplot(3,1,2)
stem(k,abs(U))
```

```
title('Magnitude of the fft DFT samples')
xlabel('Frequency index k'); ylabel('Magnitude')
subplot(3,1,3)
stem(k,angle(U))
title('Phase of the fft DFT samples')
xlabel('Frequency index k'); ylabel('Phase')
```

Result

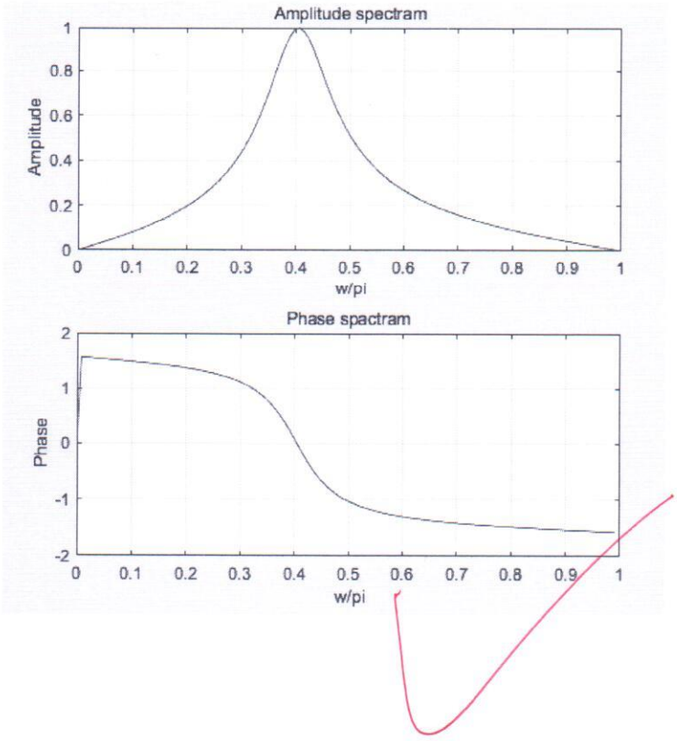


M2

MATLAB Code:

```
b=[0.15 0 -0.15];
a=[1 -0.5 0.7];
[H, omega]=freqz(b,a,128);
subplot(2,1,1)
plot(omega/pi,abs(H))
title('Amplitude spectram');
xlabel(' w/pi'); ylabel('Amplitude')
grid on
subplot(2,1,2)
plot(omega/pi,angle(H))
title('Phase spactram');
xlabel(' w/pi'); ylabel('Phase')
grid on
```

Result

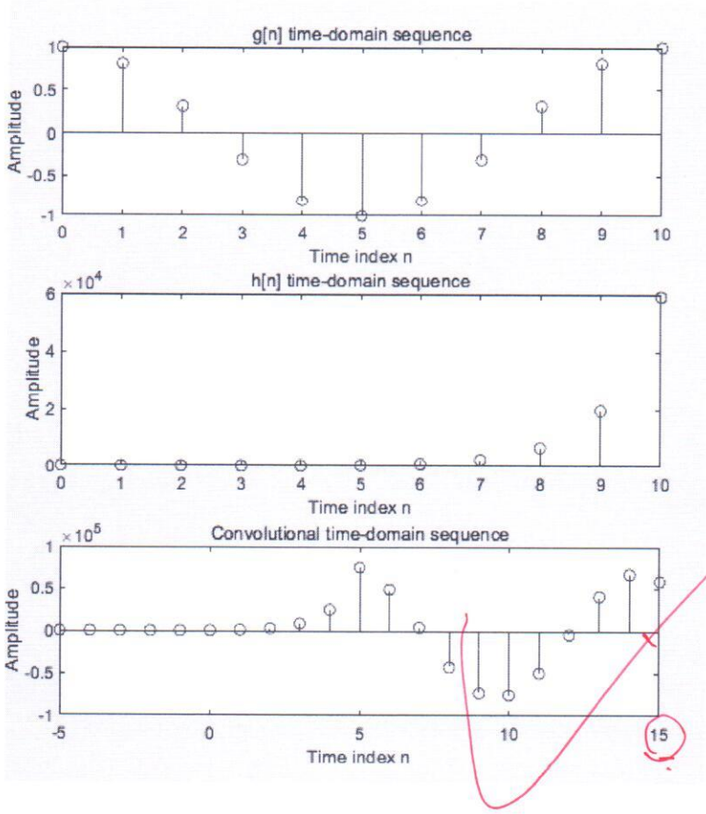


M3

MATLAB Code:

```
n = 0:1:10;
g = cos(0.2*pi*n);
h = 3.^n;
G = conv(g,h);
N = -5:1:15;
subplot(3,1,1)
stem(n,g)
title('g[n] time-domain sequence')
xlabel('Time index n'); ylabel('Amplitude')
subplot(3,1,2)
stem(n,h)
title('h[n] time-domain sequence')
xlabel('Time index n'); ylabel('Amplitude')
subplot(3,1,3)
stem(N,G)
title('Convolutional time-domain sequence')
xlabel('Time index n'); ylabel('Amplitude')
```

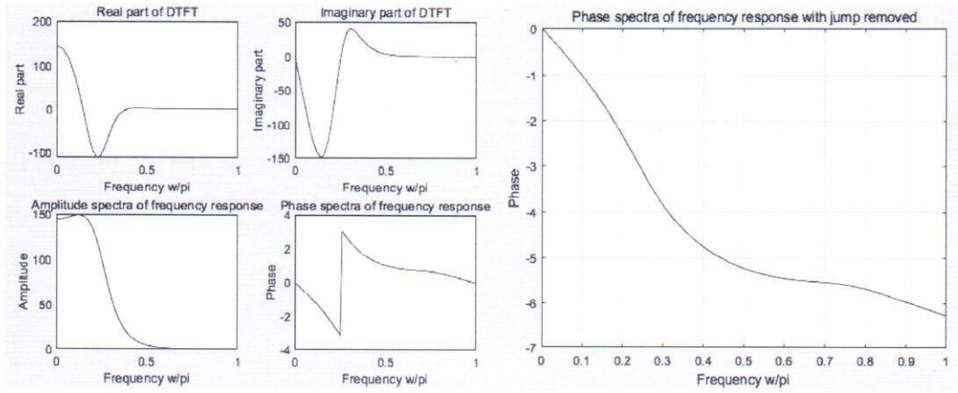
Result:



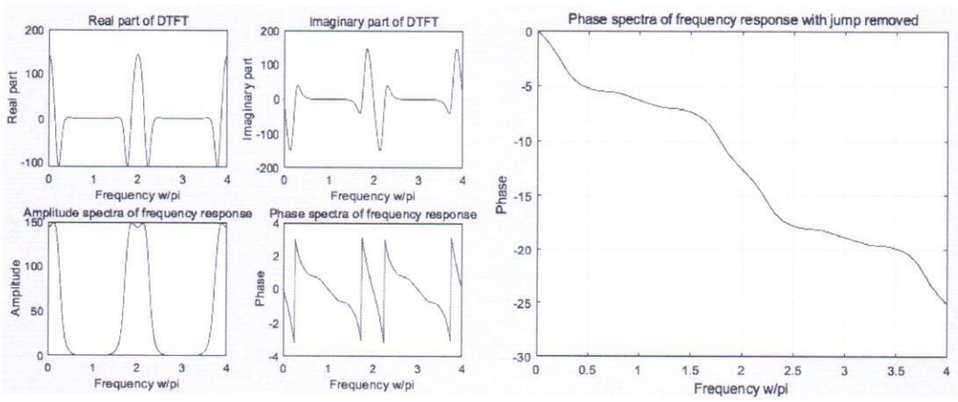
M4

MATLAB Code:

```
a = [1.35 4.95 8.55 4.95 1.8];
b = [0.9 -1.8 1.65 -0.75 0.15];
[X, omega]=freqz(a,b,0:pi/100:pi);

figure(1)
subplot(2,2,1)
plot(omega/pi,real(X))
title('Real part of DTFT');
xlabel('Frequency w/pi'); ylabel('Real part')

subplot(2,2,2)
plot(omega/pi,imag(X))
title('Imaginary part of DTFT');
xlabel('Frequency w/pi'); ylabel('Imaginary part')

subplot(2,2,3)
plot(omega/pi,abs(X))
title('Amplitude spectra of frequency response');
xlabel('Frequency w/pi'); ylabel('Amplitude')

subplot(2,2,4)
plot(omega/pi,angle(X))
title('Phase spectra of frequency response');
xlabel('Frequency w/pi'); ylabel('Phase')

figure(2)
plot(omega/pi,unwrap(angle(X)))
title('Phase spectra of frequency response with jump removed');
xlabel('Frequency w/pi'); ylabel('Phase')
grid on
```



To prove the spectrum is whether periodic or not, I have tried to show the image for $0 < \omega < 4\pi$



Conclusion:

Obviously, the period of sequence is 2π. The jump is the periodic phase drop/rise to another period with the change of sequence, as the 'unwrap' shows.

M5

MATLAB Code:

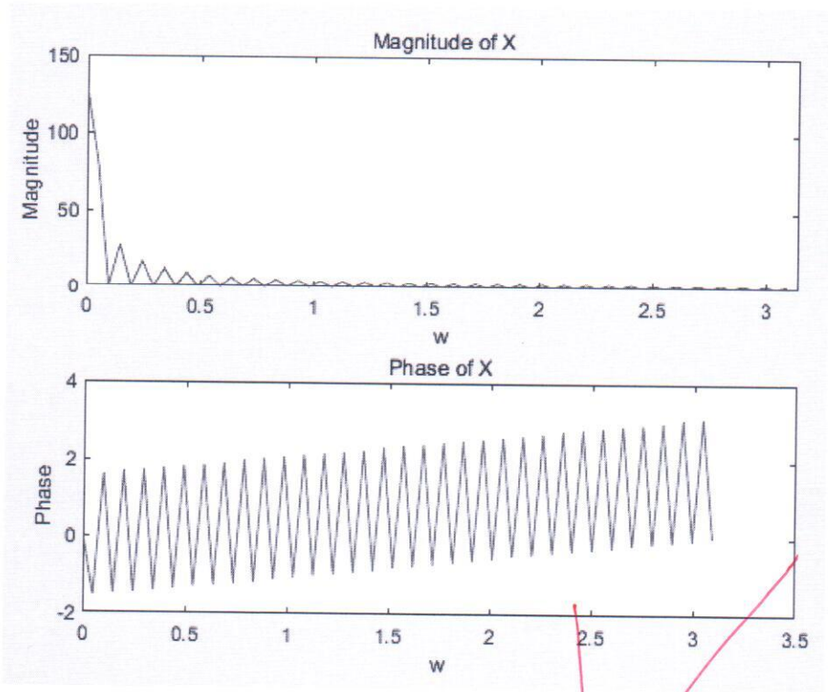
```
clear
fs=input('sampling frequency£°\n');
dt=1/fs;
t1=0:dt:63*dt;
```

```
x1 = sin(0.1*pi*t1)+2*cos(0.3*pi*t1)+3*sin(0.5*pi*t1);
[X,w] = freqz(x1,1,64);

subplot(2,1,1);
plot(w,abs(X));
axis([0 pi 0 150]);
xlabel('w');
ylabel('Magnitude');
title('Magnitude of X');
subplot(2,1,2);
plot(w,angle(X));
xlabel('w');
ylabel('Phase');
title('Phase of X');
```

WITH

```
>> Program_lab_5
sampling frequency:
20000
```

Conclusion:



A+