BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

SECOND SEMESTER 2019-2020

EEE F243 - Signals and Systems

MATLAB-BASED ASSIGNMENT: Open Book

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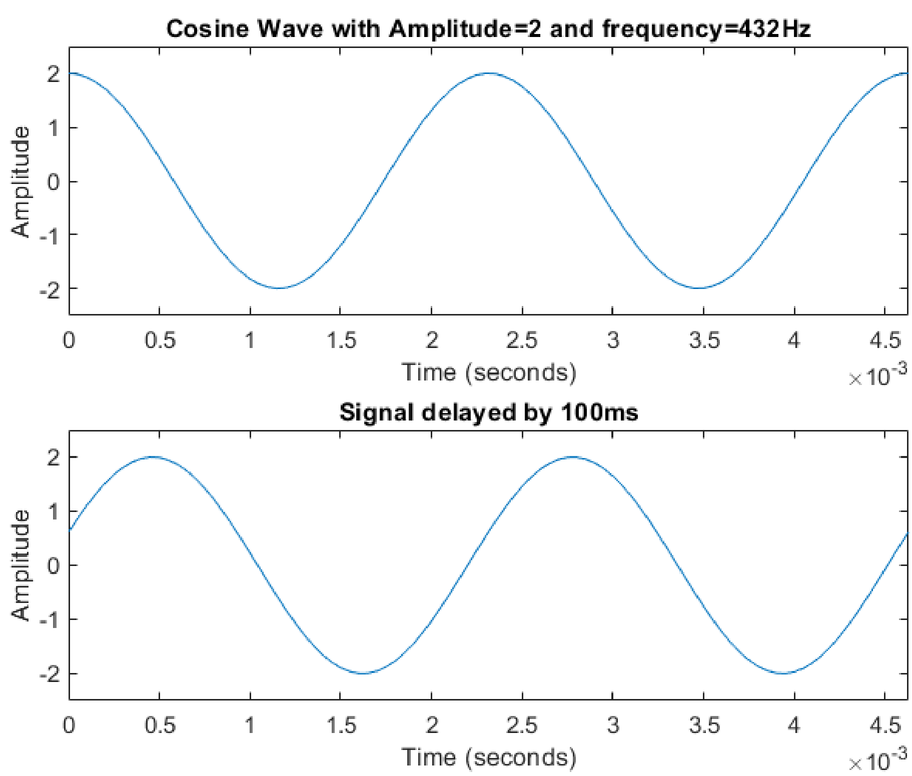
Tutorial Section: T-4

Solution for Question 1

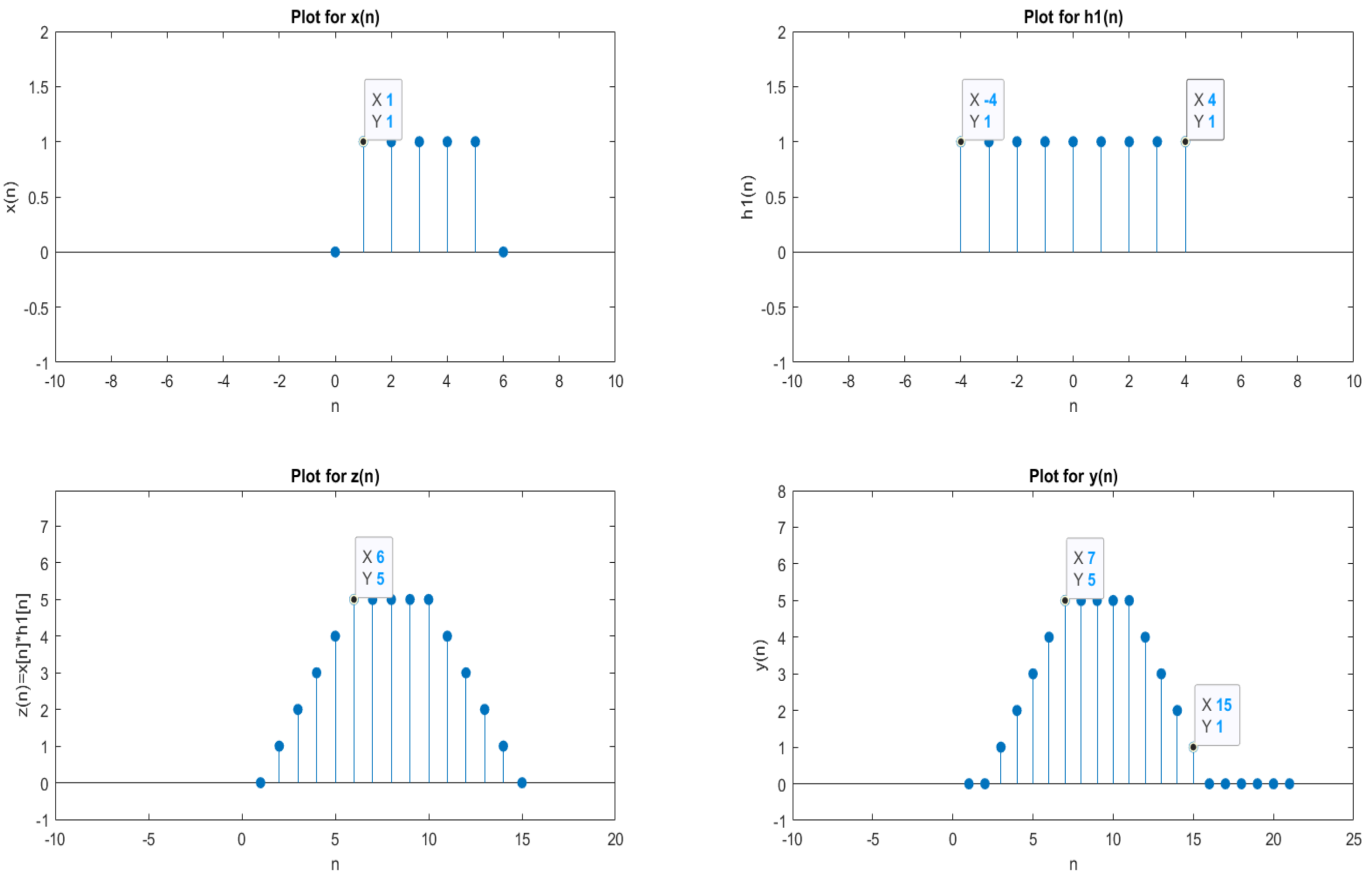
```
fs = 20000; % Sampling frequency (samples per second)
Ts = 1/fs; % seconds per sample
StopTime = 2; % seconds
t = (0:Ts:StopTime);

%Sine wave
F = 432; % Sine wave frequency (hertz)
T=1/F;

% Q1 Part-a
subplot(2,1,1)
x = 2*cos(2*pi*F*t);
plot(t,x);

%For two cycles
xlim([0 2*T]);
ylim([-2.5 2.5]);
xlabel('Time (seconds)')
ylabel('Amplitude')
title('Cosine Wave with Amplitude=2 and frequency=432Hz')

% Q1 Part-b
subplot(2,1,2)
x_d = 2*cos(2*pi*F*(t-0.1));
plot(t,x_d);
xlim([0 2*T]);
ylim([-2.5 2.5]);
xlabel('Time (seconds)')
ylabel('Amplitude')
title('Signal delayed by 100ms')
```



Solution for Question 2

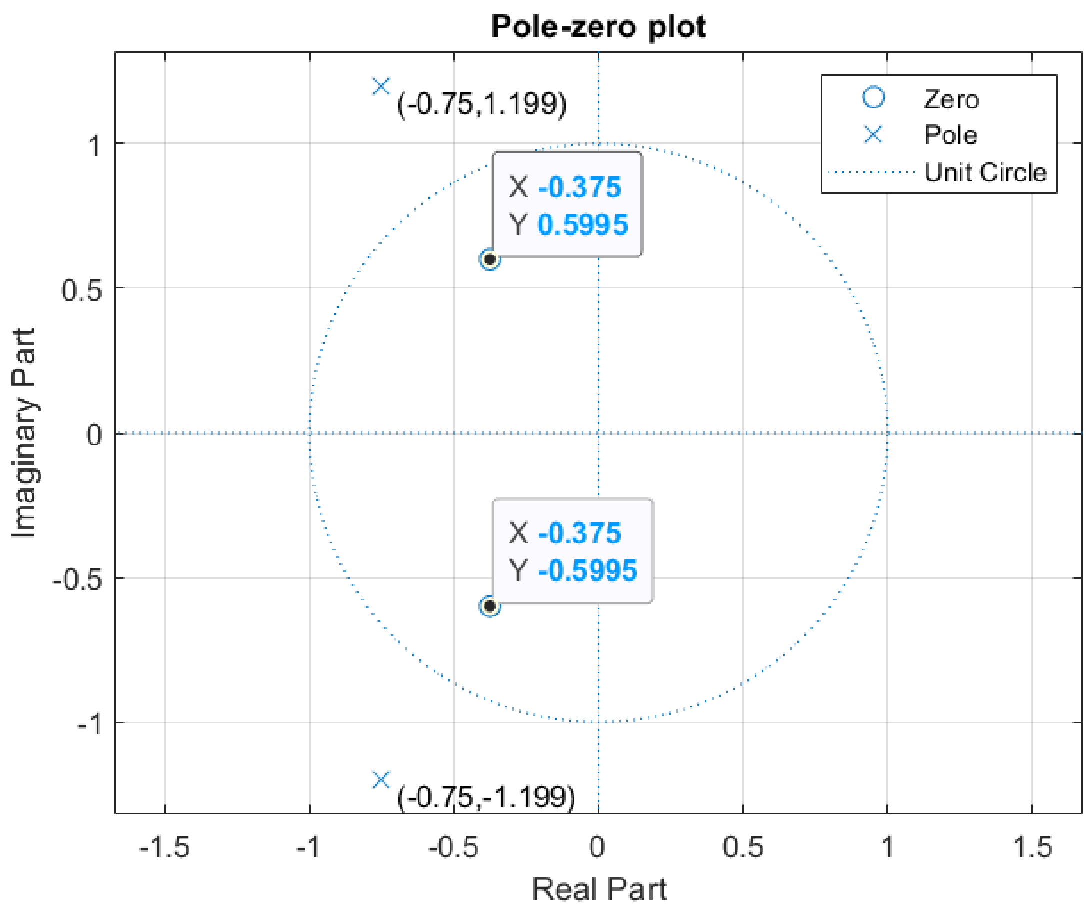
```
% defining x[n]
nx=0:6;
sympref('HeavisideAtOrigin',1);
y1=heaviside(nx-1);
y2=heaviside(nx-6);
x=y1-y2;
subplot(2,2,1)
stem(nx,x,"filled")
axis([-10 10 -1 2])
xlabel('n')
ylabel('x(n)')
title('Plot for x(n)')


% defining h1[n]
nh1=-4:4;
sympref('HeavisideAtOrigin',1);
y3=heaviside(nh1+4);
y4=heaviside(nh1-5);
h1=y3-y4;
subplot(2,2,2)
stem(nh1,h1,"filled")
axis([-10 10 -1 2])
xlabel('n')
ylabel('h1(n)')
title('Plot for h1(n)')


%defining x[n] conv h1[n]
z=conv(x,h1);
subplot(2,2,3)
stem(z,"filled")
axis([-10 20 -1 8])
xlabel('n')
ylabel('z(n)=x[n]*h1[n]')
title('Plot for z(n)')


%defining h2[n]
nh2=0:6;
sympref('HeavisideAtOrigin',1);
y5=heaviside(nx-1);
y6=heaviside(nx-2);
h2=y5-y6;


%defining output y[n]
y=conv(h2,z);
subplot(2,2,4)
```

```
stem(y,"filled")
axis([-10 25 -1 8])
xlabel('n')
ylabel('y(n)')
title('Plot for y(n)')
```



Solution for Question 3

```
%H=tf([4 3 2],[2 3 4]);
B=([4 3 2]);
A=([2 3 4]);


zplane(B,A);
legend('Zero','Pole', 'Unit Circle')
title("Pole-zero plot")
grid on


%displaying coordinates of poles
xp=real(roots(A));
yp=imag(roots(A));


for i=1:2
text(xp(i)+0.05,yp(i)-0.05,['(',num2str(xp(i)), ',', num2str(yp(i)), ')'])
end
```



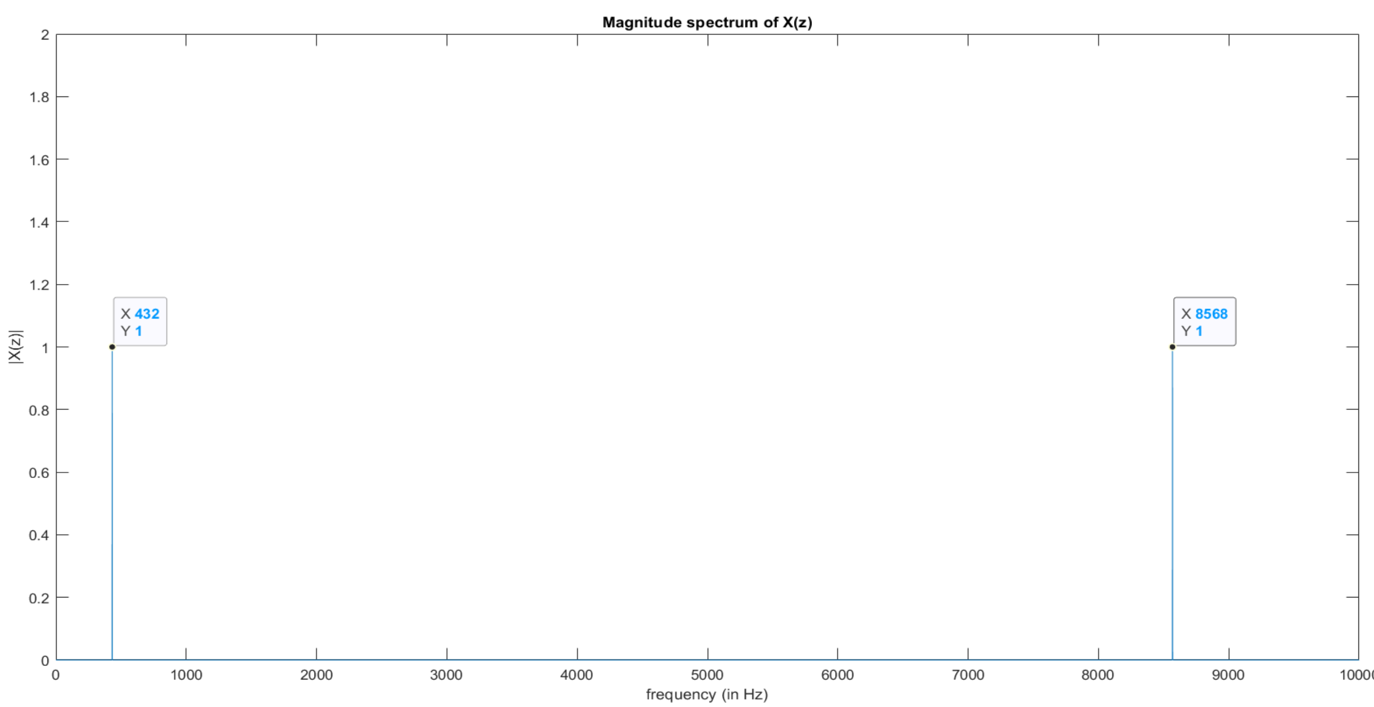
Stability of the system :

Since H(z) is causal (and rational) and the poles lie outside |z|= 1, therefore we conclude that system is unstable.

Solution for Question 4

```
fs=20000;
Ts=1/fs;
StopTime=2;
t = (0:Ts:StopTime);
L = fs*StopTime;


%signal-1
f1=432;
T1=1/f1;
x1=2*cos(2*pi*f1*t);
```

```
%Signal-2
f2=11432;
T2=1/f2;
x2=2*cos(2*pi*f2*t);


x=x1+x2;
y=fft(x,fs);


p1 = abs(y/L);
f=(0:1:fs-1);
plot(f,2*p1);
axis([0 10000 0 2])


xlabel('frequency (in Hz)')
ylabel('|X(z)|')
title('Magnitude spectrum of X(z)')
```



Observations:

The plot has two unit impulses : δ [2π(f - 432)] and δ[2π(f - 8568)] = δ[2π(f -(20000 - 11432))] as expected within the range f ε [0, 10000] Hz. If plotted till 20000Hz, the plot shows symmetry

which is in accordance to the fact that symmetry is expected at fs/2 which corresponds to $\omega/\omega s = \pi$.
Also, since the stop time is 2 seconds, I have considered the length of the signal as 2*fs.