Department of Electrical Engineering

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Course/Section: BEE-6B **Semester:** 4th Semester

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EE-232Signals and Systems

Lab Report #4 Introduction to Complex Exponentials

Pre lab task

a)

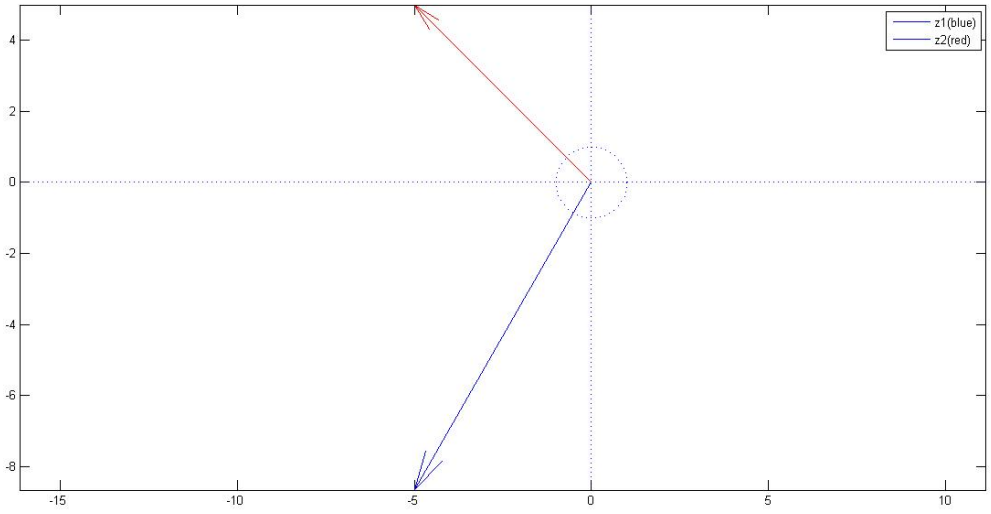
Matlab code:

```
clear all
clc
z1=10*exp(-j*2*pi/3);
z2=-5+5*j;
disp('z1');
zprint(z1)
disp('z2');
zprint(z2)
zvect(z1,'b-')
hold on
zvect(z2,'r-')
legend('z1(blue)','z2(red)')
zcoords,ucplot,hold off
```

Matlab output:

```
z1
 Z =     X    +     jY     Magnitude     Phase     Ph/pi    Ph(deg)
          -5        -8.66          10    -2.094    -0.667   -120.00

z2
 Z =     X    +     jY     Magnitude     Phase     Ph/pi    Ph(deg)
          -5           5       7.071     2.356     0.750    135.00
```

Matlab graph:

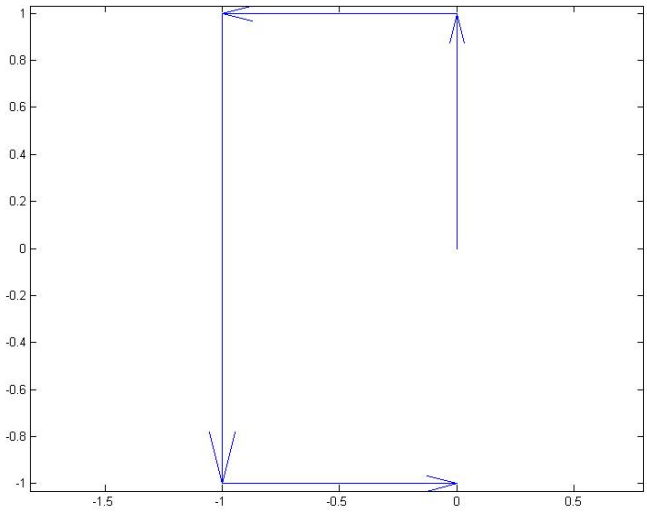


b)

Matlab code:

```
clear all
clc
zcat([j,-1,-2j,1])
```

Matlab graph:



c)

Matlab code:

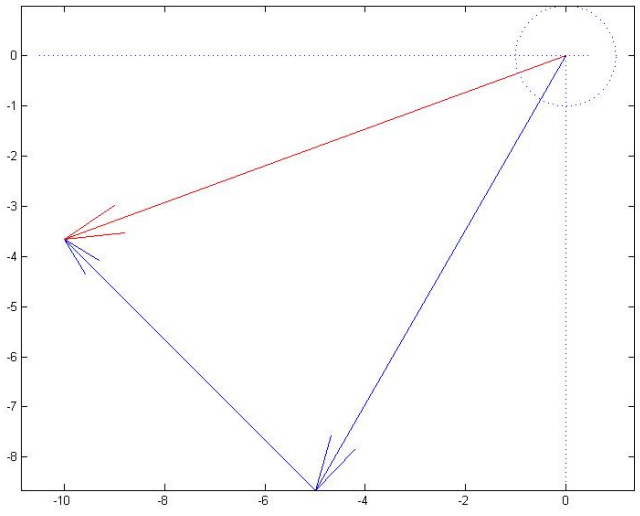
```
clear all
clc
z1=10*exp(-j*2*pi/3);
z2=-5+5*j;
z=z1+z2;
zcat([z1,z2])
hold on
zcat(z,'r-')
zcoords,ucplot,hold off
zprint(z);
```

Matlab output:

```
Z =      X     +      jY      Magnitude     Phase     Ph/pi    Ph(deg)
         -10          -3.66        10.65    -2.791    -0.888   -159.90
```

Phase angle is: -159.9^{o}

Matlab graph:



d)

Matlab code:

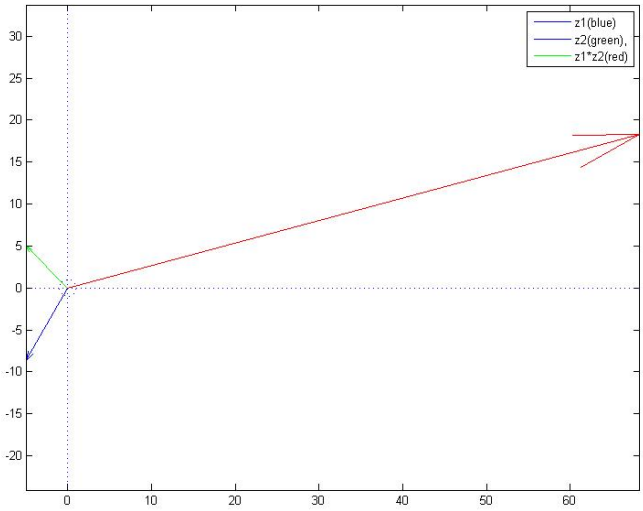
```
clear all
clc
z1=10*exp(-j*2*pi/3);
z2=-5+5*j;
z=z1*z2;
zprint(z);
zvect(z1,'b-')
hold on
zvect(z2,'g-')
zvect(z,'r-')
legend('z1(blue)','z2(green),','z1*z2(red)')
zcoords,ucplot,hold off
```

Matlab output:

```
Z =      X      +      jY      Magnitude      Phase      Ph/pi      Ph(deg)
        68.3           18.3          70.71      0.262      0.083       15.00
```

Phase angle is: 15^{o}

Matlab graph:



e)

Matlab code:

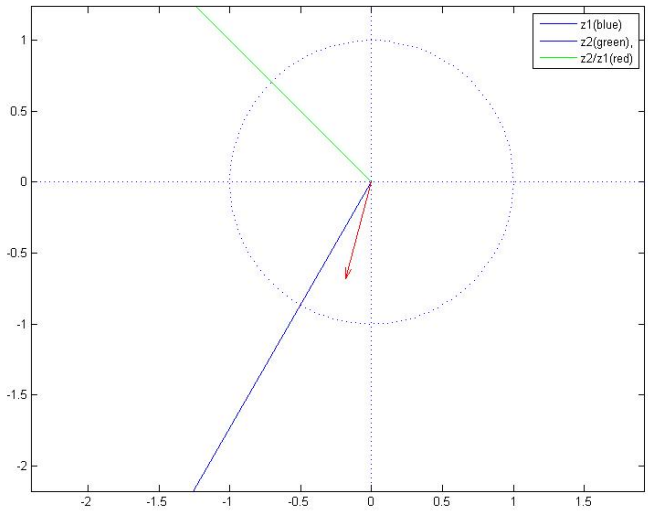
```
clear all
clc
z1=10*exp(-j*2*pi/3);
z2=-5+5*j;
z=z2/z1;
zprint(z);
zvect(z1,'b-')
hold on
zvect(z2,'g-')
zvect(z,'r-')
legend('z1(blue)','z2(green)','z2/z1(red)')
zcoords,ucplot,hold off
```

Matlab output:

```
Z =      X      +      jY      Magnitude      Phase      Ph/pi     Ph(deg)
       -0.183         -0.683        0.7071    -1.833    -0.583   -105.00
```

Phase angle is: -105.00^{o}

Matlab graph:



f)

Matlab code:

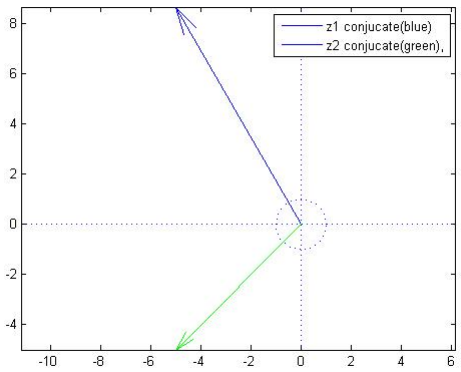
```
clear all
clc
z1=10*exp(-j*2*pi/3);
z2=-5+5*j;
z1conj=conj(z1);
z2conj=conj(z2);
disp('Conjugate of z1')
zprint(z1conj)
disp('Conjugate of z2')
zprint(z2conj)
zvect(z1conj,'b-')
hold on
zvect(z2conj,'g-')
legend('z1 conj(blue)','z2 conj(green),'),zcoords,ucplot,hold off
```

Matlab output:

```
conjucate of z1
 Z =      X     +      jY      Magnitude     Phase     Ph/pi    Ph(deg)
           -5          8.66           10     2.094     0.667    120.00

conjucate of z2
 Z =      X     +      jY      Magnitude     Phase     Ph/pi    Ph(deg)
           -5            -5        7.071    -2.356    -0.750   -135.00
```

Phase angle of z1*: 120.00^{o}
Phase angle of z2*: -135.00^{o}

Matlab graph:



g)

Matlab code:

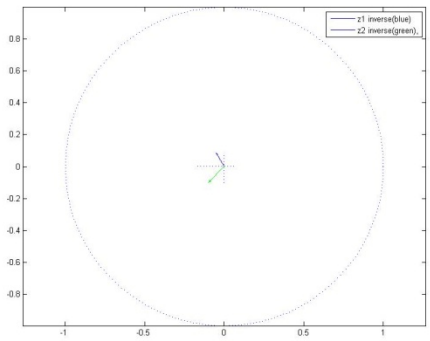
```
clear all
clc
z1=10*exp(-j*2*pi/3);
z2=-5+5*j;
z1i=1/z1;
z2i=1/z2;
disp('Inverse of z1')
zprint(z1i)
disp('Inverse of z2')
zprint(z2i)
zvect(z1i,'b-')
hold on
zvect(z2i,'g-')
legend('z1 inverse(blue)','z2 inverse(green),'),zcoords,ucplot,hold off
```

Matlab output:

```
Inverse of z1
 Z =      X     +      jY      Magnitude     Phase     Ph/pi    Ph(deg)
        -0.05        0.0866          0.1     2.094     0.667    120.00

Inverse of z2
 Z =      X     +      jY      Magnitude     Phase     Ph/pi    Ph(deg)
         -0.1          -0.1         0.1414   -2.356    -0.750  -135.00
```

Phase angle of z1 inverse: 120.00^{o}
Phase angle of z2 inverse: -135.00^{o}

Matlab graph:

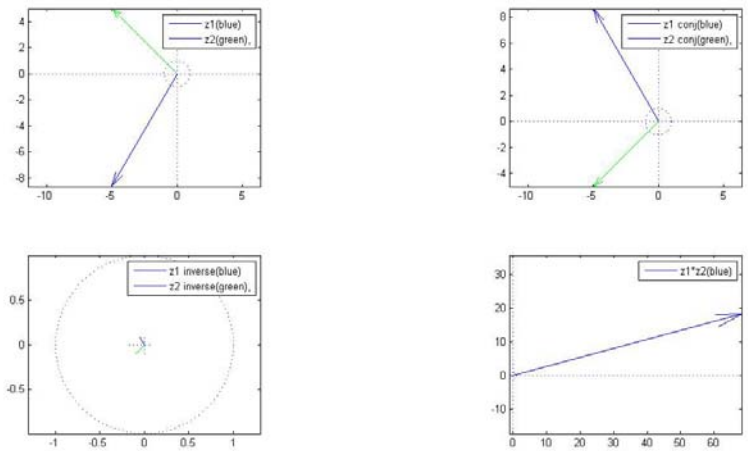


h)

Matlab code:

```
clear all
clc
z1=10*exp(-j*2*pi/3);
z2=-5+5*j;
z1conj=conj(z1);
z2conj=conj(z2);
z1i=1/z1;
z2i=1/z2;
zp=z1*z2;
subplot(2,2,1);
zvect(z1,'b-')
hold on
zvect(z2,'g-')
legend('z1(blue)','z2(green),'),zcoords,ucplot,hold off
subplot(2,2,2);
zvect(z1conj,'b-')
hold on
zvect(z2conj,'g-')
legend('z1 conj(blue)','z2 conj(green),'),zcoords,ucplot,hold off
subplot(2,2,3);
zvect(z1i,'b-')
hold on
zvect(z2i,'g-')
legend('z1 inverse(blue)','z2 inverse(green),'),zcoords,ucplot,hold off
subplot(2,2,4);
zvect(zp,'b-')
hold on
legend('z1*z2(blue)'),zcoords,ucplot,hold off
```

Matlab graph:



Lab task no.1:

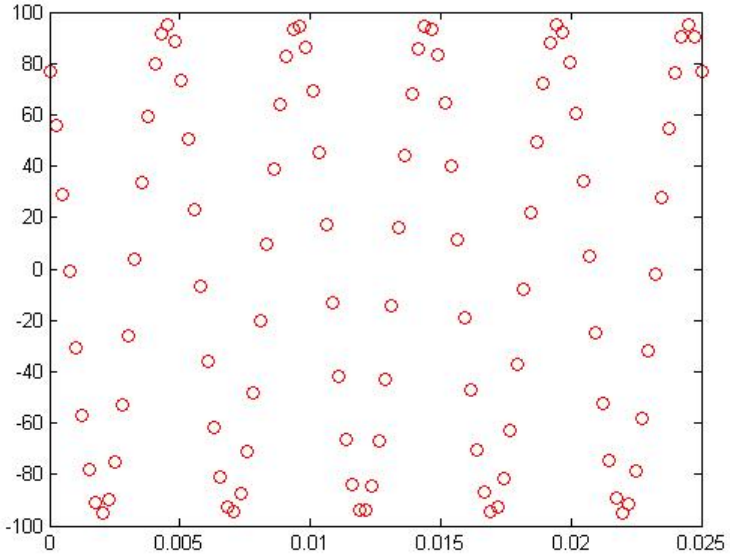
goodcos.m file code:

```
function [Y]=goodcos(A,w,o,dur)
Y(:,1)=linspace(0,dur,floor((w*dur*20)));
Y(:,2)=A*cos(2*pi*w*Y(1:length(Y),1)+o);
```

Matlab Command window input:

```
>> g=goodcos(95,200,pi/5,0.025)
% In order to plot the given cos function
>> plot(g(:,1),g(:,2),'ro')
```

Matlab plot:



Lab task no.2:

Syn_sin.m file code:

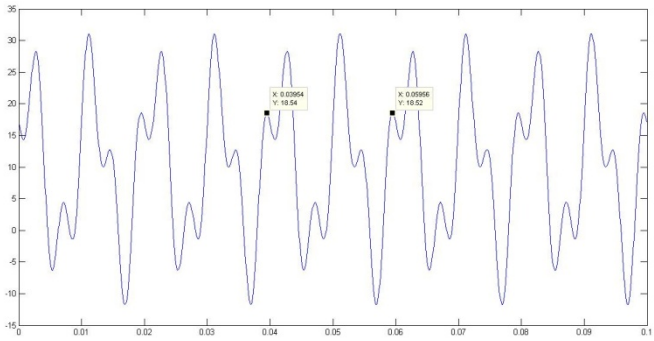
```
function [xx,tt]=syn_sin(fk, Xk, fs, dur, tstart)

if nargin<5
    tstart=0;    %--default value is zero
end

 if length(fk)==length(Xk)

tt=linspace(tstart,dur+tstart,fs*dur); %duration in sec
m=length(Xk);
for k=1:length(tt)%qq=length(Xk):length(tt) matrix
    qq(:,k)=real(Xk(1:m).*exp(j*fk(1:m)*2*pi*tt(k)));
    k =k+1;
end
xx=sum(qq);%sum of rows
plot(tt,xx)%Required graph
else
    disp('Error is frequencies input')
end
```

Three signals with (0, 200pi, 500pi) angular frequency, now signal frequency should H:C:F , so signal has 100pi angular frequency and 50Hz frequency.
From graph, Time period is 20m sec then frequency comes out to be same 50Hz. Verified
As, H:C:F never be greater than least non-zero integer data. So, time period will always be greater than individual frequencies time period

Matlab Command window input:

```
syn_sin([0,100,250],[10,14*exp(-j*pi/3),8*j],10000,0.1,0)
```

Matlab plot:



Lab task no.3:

Matlab Command window input:

```
syn_sin([1/2,1/2,1/2],[2,2*exp(-1.25*j*pi),(1-j)],10000,6,-0.5)
```

After solving the expression, π comes out to be angular frequency. Therefore, time period comes out to be 2 seconds. For three full signals, duration should be equal to 6 seconds. As seen above in command window input arguments.

Matlab plot: