EXP:1 DIPOLE ANTENNA

```
% 23A91A0457
%sk.dilwar
% ECE-A
lamda=input('enter the value of wave length : ');
l=input('enter your dipole length : ');
ratio = l/lamda;
B=(2*pi/lamda);
theta=pi/100:pi/100:2*pi;
if ratio <=0.1
    E=sin(theta);
    En=abs(E);
    subplot(2,1,1);
    polar(theta,En);
else
    f1=cos(B*l/2.*cos(theta));
    f2=cos(B*1/2);
    f3=sin(theta);
    E=(f1-f2)./f3;
    En=abs(E);
    subplot(2,1,2);
    polar(theta,En);
end
```

Output :

>> dipole_antenna
enter the value of wave length : 5
enter your dipole length : 1
>> dipole_antenna
enter the value of wave length : 1
enter your dipole length : 5
>> dipole_antenna
enter the value of wave length : 1
enter your dipole length : 1
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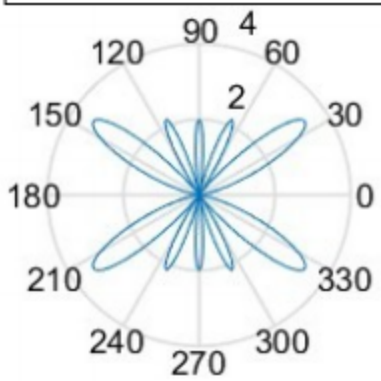
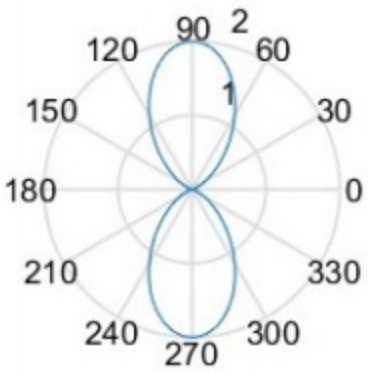
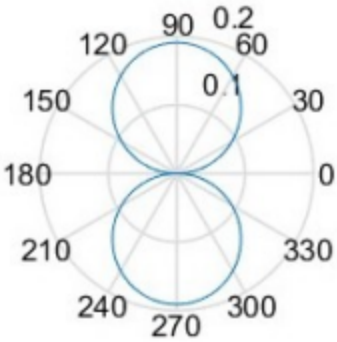
Wave Length = 1
Dipole length = 5



Wave Length = 1
Dipole length = 1



Wave Length = 5
Dipole length = 1



2 . MONOPOLE ANTENNA

```
% 23A91A0457
% sk.Dilwar
% ECE-A
lamda = input('enter the value of wave length = ');
l = input('enter your monopole length = ');
ratio = l/lamda;
B = (2*pi/lamda);
theta =0:pi/100:pi;
if ratio<=0.1
    E=sin(theta);
    En=abs(E);
    subplot(1,1,1);
    polarplot(theta,En);
else
    f1 = cos(B*l/2.*cos(theta));
    f2 = cos(B*l/2);
    f3 = sin(theta);
    E = (f1-f2)./f3;
    En = abs(E);
    subplot(1,1,1)
    polarplot(theta,En)
end
```

OUTPUT :

```
>> monopole_antenna
enter the value of wave length = 10
enter your monopole length = 100
```

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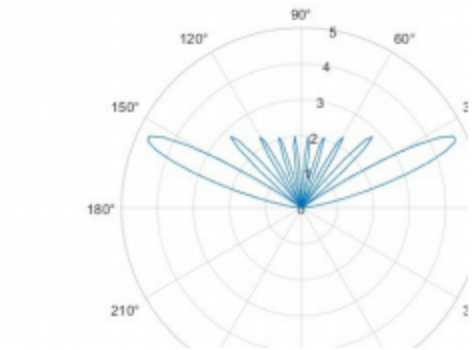
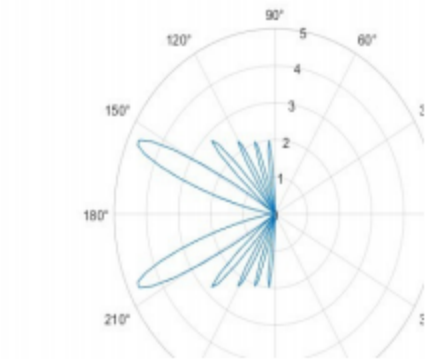
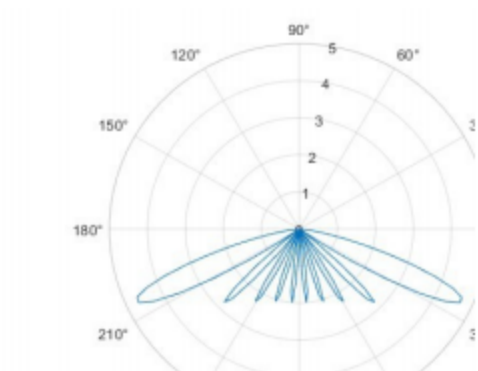
Case:1
0<theta<pi/2



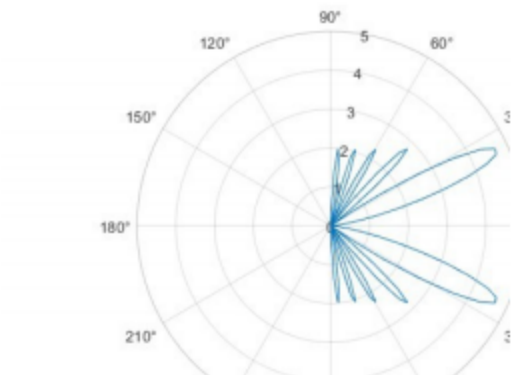
Case:2
Pi/2<theta<3pi/2



Case:3
Pi<theta<2pi



Case:4
3pi/2<theta<5pi/2



EXPERIMENT-3

```
%23A91A0457
%Sk.Dilwar
%ECE-A
%23/07/2025
lamda= input('enter the value of Lambda: ');
N= input('enter the number of elements: ');
alfa = input('enter the progressive phase: ');
d= input('enter the separation distance between elements: ');
B=(2*pi/lamda);
theta=pi/100:pi/100:2*pi;
w=alfa+B*d.*cos(theta);
AF=sinc(N*(w./2))./sinc(w./2);
subplot(1,1,1);
polar(theta,AF);
```

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OUTPUT :

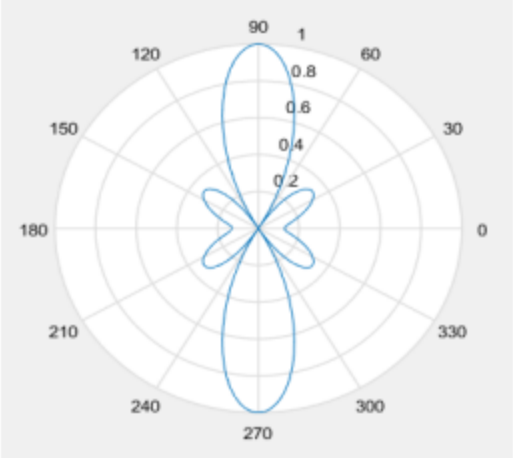
Case:1

enter the value of wavelength=10

enter the no.of elements=2

enter your progressive phase=0

enter the seperation distance between elements=3



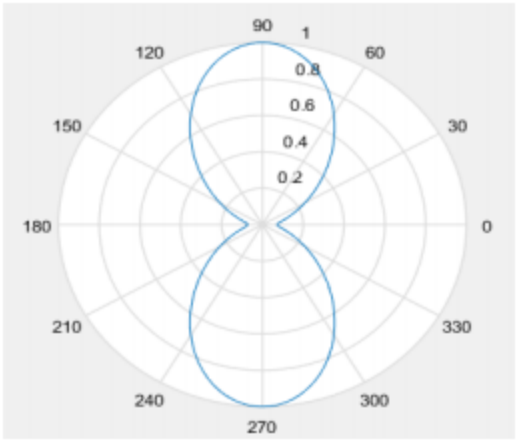
Case:2

enter the value of wavelength=50

enter the no.of elements=3

enter your progressive phase=0

enter the seperation distance between elements=5



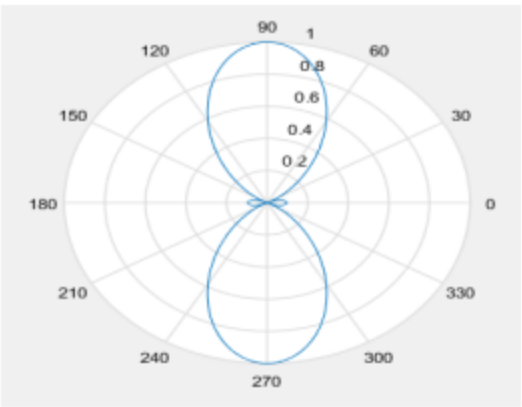
Case:3

enter the value of wavelength=100

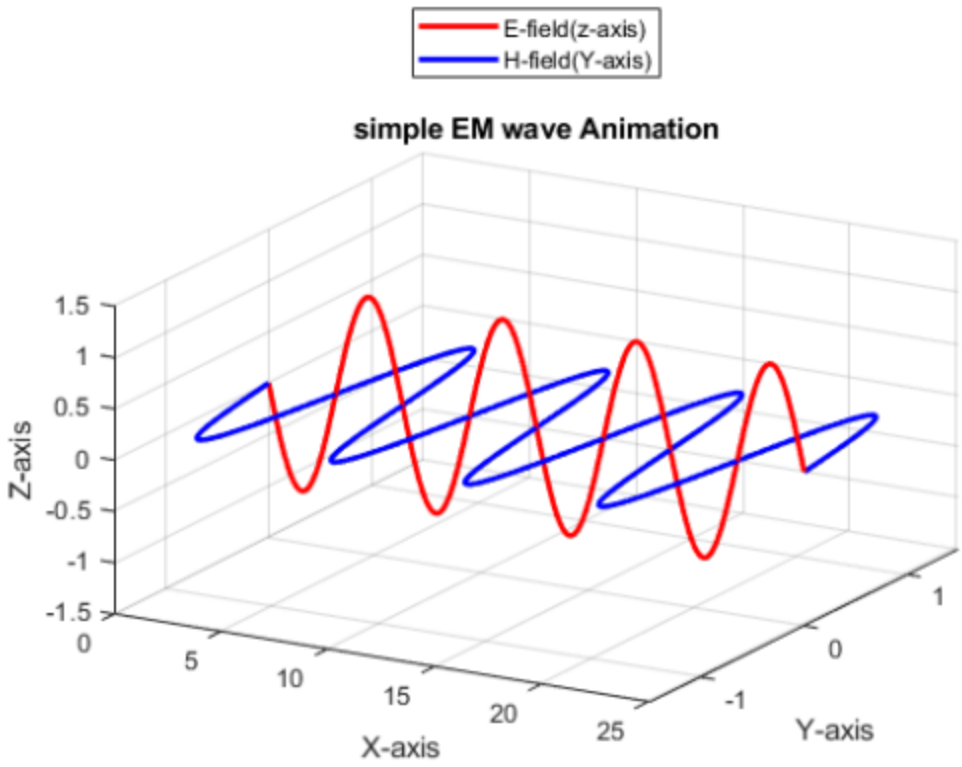
enter the no.of elements=5

enter your progressive phase=0

enter the seperation distance between elements=7



```
%23A91A0457
%Sk.Dilwar
%ECE-A
%30/07/2025
function simple_EM_wave()
lambda = 2*pi;
k = 2*pi/lambda;
omega = 2*pi;
x = linspace(0,4*lambda,200);
dt = 0.1;
figure('color','w');
axis tight manual
for t = 0:dt:4*pi;
    E = sin(k*x-omega*t);   %E field (z direction)
    H = sin(k*x-omega*t);   %H field (Y direction)
    plot3(x,zeros(size(x)),E,'r','linewidth',2); hold on; % E field
    plot3(x,H,zeros(size(x)),'b','linewidth',2);            % H field
    legend('E-field(z-axis)','H-field(Y-axis)','location','north outside');
    xlabel('X-axis');ylabel('Y-axis');zlabel('Z-axis');
    title('simple EM wave Animation');
    axis([0 4*lambda -1.5 1.5 -1.5 1.5]); view([30 30]); grid on;
    pause(0.05);hold off;
end
end
```



EXPERIMENT-5

```
%23A91A0457
%Sk.Dilwar
%ECE-A
%06/08/2025
clc;
clear all;
close all;
Z0 = 50;
ZL = 25+1j*50;
%ZL = 100-1J*30;
%ZL = 50;
%REFLECTION COEFFICIENT
gammaL = (ZL-Z0)/(ZL+Z0);
%PLOT SMITH CHART
figure;
smithplot;hold on;
plot(real(gammaL),imag(gammaL),'ro','MarkerSize',8,'linewidth',2);
title('Smith Chart-Single Stub Matching');
grid on;
zL=ZL/Z0;
yL=1/zL;
b=imag(yL);
ymatched=1+1j*(b-b);
zmatched=1;
plot(0,0,'gs','MarkerSize',10,'LineWidth',2);
%show text on chart
str1 = ['ZL =' num2str(real(ZL)) ' + j' num2str(imag(ZL))];
text(real(gammaL),imag(gammaL)+0.1,str1,'FontSize',12,'Color','blue'
);
text(-0.1,0.1,'Matched Point','FontSize',12,'Color','green');
%print values in command window
fprintf('Z0 =%.2f ohm\n',Z0);
fprintf('Load ZL = %.2f%+.2fj ohm\n',real(ZL),imag(ZL));
fprintf('reflection
coefficient(gammaL)=%.3f%+.3fj\n',real(gammaL),imag(gammaL));
fprintf('|gammaL|=%.3f\n',abs(gammaL));
fprintf('VSWR(Before Matching)=%.3f\n',(1+abs(gammaL))/(1-
abs(gammaL)));
fprintf('After Matching:Zin=%.2f ohm(Perfect Match!)\n',Z0);
```

OUTPUT :

INDUCTIVE LOAD

Z0 =50.00 ohm

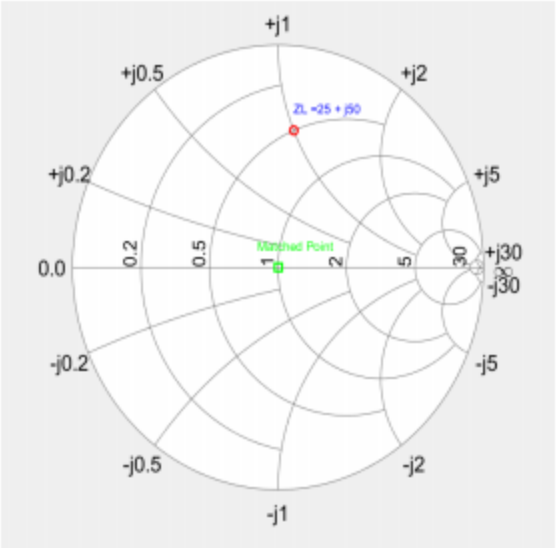
Load ZL = 25.00+50.00j ohm

reflection coefficient(gammaL)=0.077+0.615j

|gammaL|=0.620

VSWR(Before Matching)=4.266

After Matching:Zin=50.00 ohm(Perfect Match!)



CAPACITIVE LOAD

Z0 =50.00 ohm

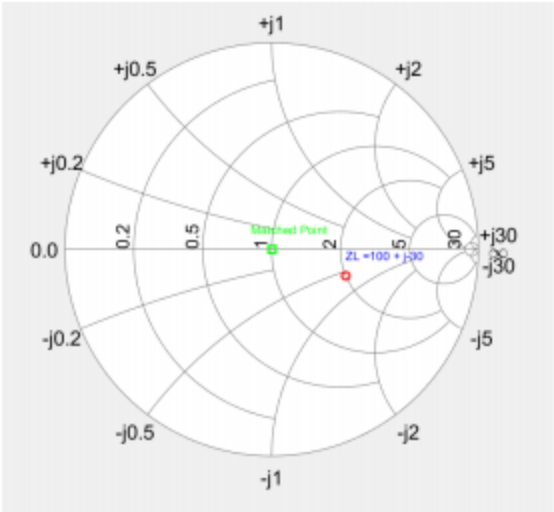
Load ZL = 100.00-30.00j ohm

reflection coefficient(gammaL)=0.359-0.128j

|gammaL|=0.381

VSWR(Before Matching)=2.232

After Matching:Zin=50.00 ohm(Perfect Match!)



RESISTIVE LOAD

Z0 =50.00 ohm

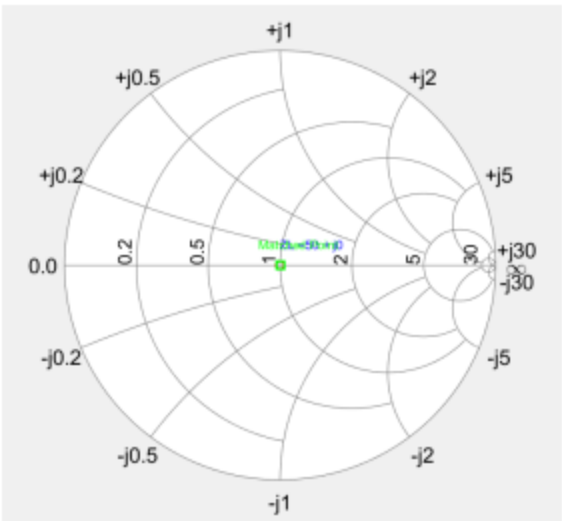
Load ZL = 50.00+0.00j ohm

reflection coefficient(gammaL)=0.000+0.000j

|gammaL|=0.000

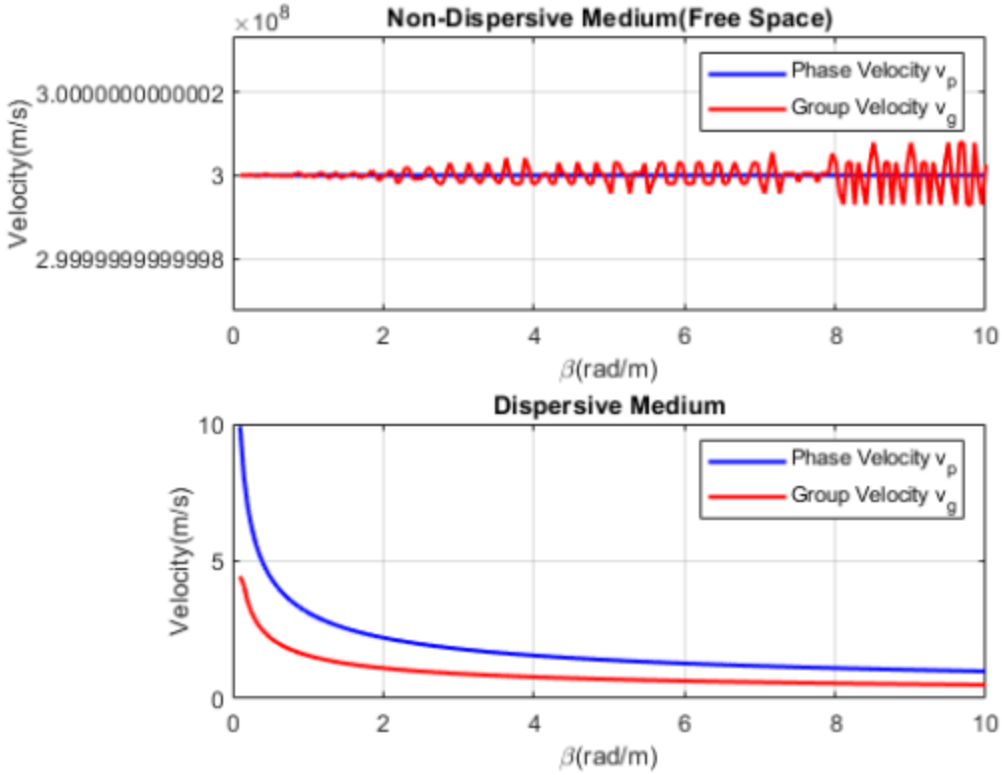
VSWR(Before Matching)=1.000

After Matching:Zin=50.00 ohm(Perfect Match!)



```
%23A91A0457
%Sk.Dilwar
%ECE-A
%13/08/2025
clc;clear;close all;
format short;
%Common beta range
beta=linspace(0.1,10,200);%rad/m
%NON-DISPERSIVE MEDIUM
c=3e8;%Speed of light in m/s
omega_nd=c.*beta;%Angular Frequency Relation
vp_nd=omega_nd./beta;%Phase Velocity
vg_nd=gradient(omega_nd,beta(2)-beta(1));%Group Velocity
fprintf('Non-Dispersive:vp=%.4f m/s,vg=%.4f m/s \n',vp_nd(100),vg_nd(100));
%DISPERSIVE MEDIUM
g=9.81;%Gravity Acceleration m/s^2
omega_d=sqrt(g.*beta);%Angular Frequency Relation
vp_d=omega_d./beta;%Phase Velocity
vg_d=gradient(omega_d,beta(2)-beta(1));%Group Velocity
fprintf('Dispersive:vp=%.4f m/s,vg=%.4f m/s \n',vp_d(100),vg_d(100));
figure;
%NON-DISPERSIVE PLOT
subplot(2,1,1);
plot(beta,vp_nd,'b','LineWidth',1.5);hold on;
plot(beta,vg_nd,'r-','LineWidth',1.5);
xlabel('\beta(rad/m)');ylabel('Velocity(m/s)');
title('Non-Dispersive Medium(Free Space)');
legend('Phase Velocity v_p','Group Velocity v_g');
grid on;
%DISPERSIVE PLOT
subplot(2,1,2);
plot(beta,vp_d,'b','LineWidth',1.5);hold on;
plot(beta,vg_d,'r-','LineWidth',1.5);
xlabel('\beta(rad/m)');ylabel('Velocity(m/s)');
title('Dispersive Medium');
legend('Phase Velocity v_p','Group Velocity v_g');
grid on;
```

```
Non-Dispersive:vp=300000000.0000 m/s,vg=300000000.0000 m/s
Dispersive:vp=1.3972 m/s,vg=0.6986 m/s
```



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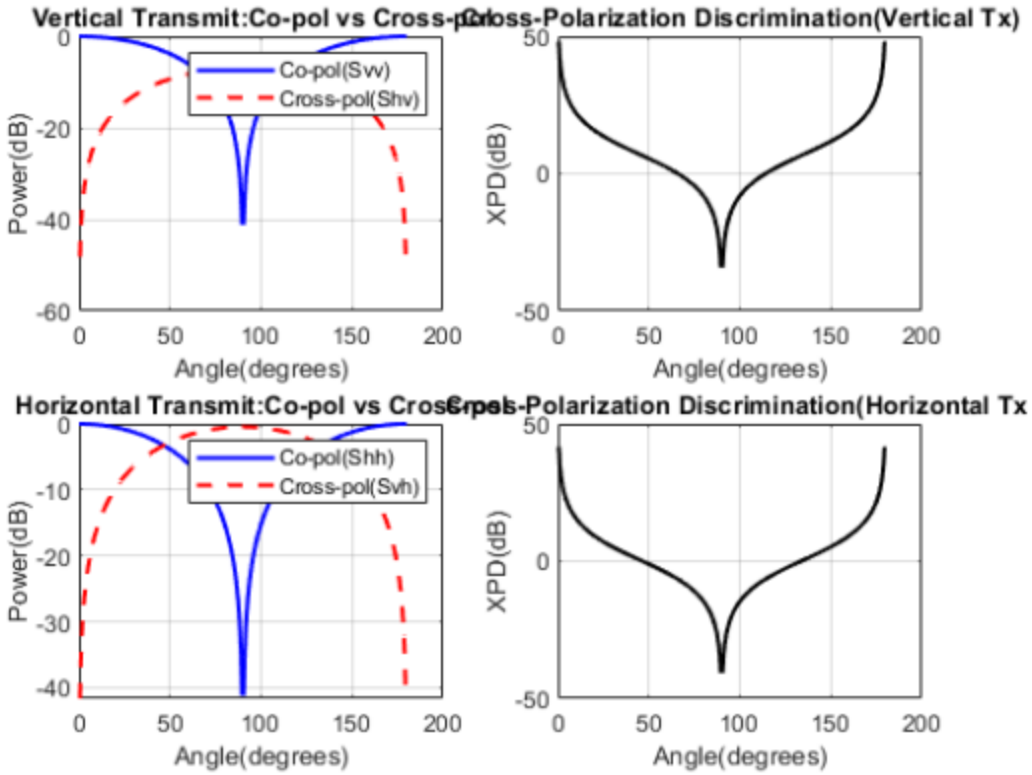
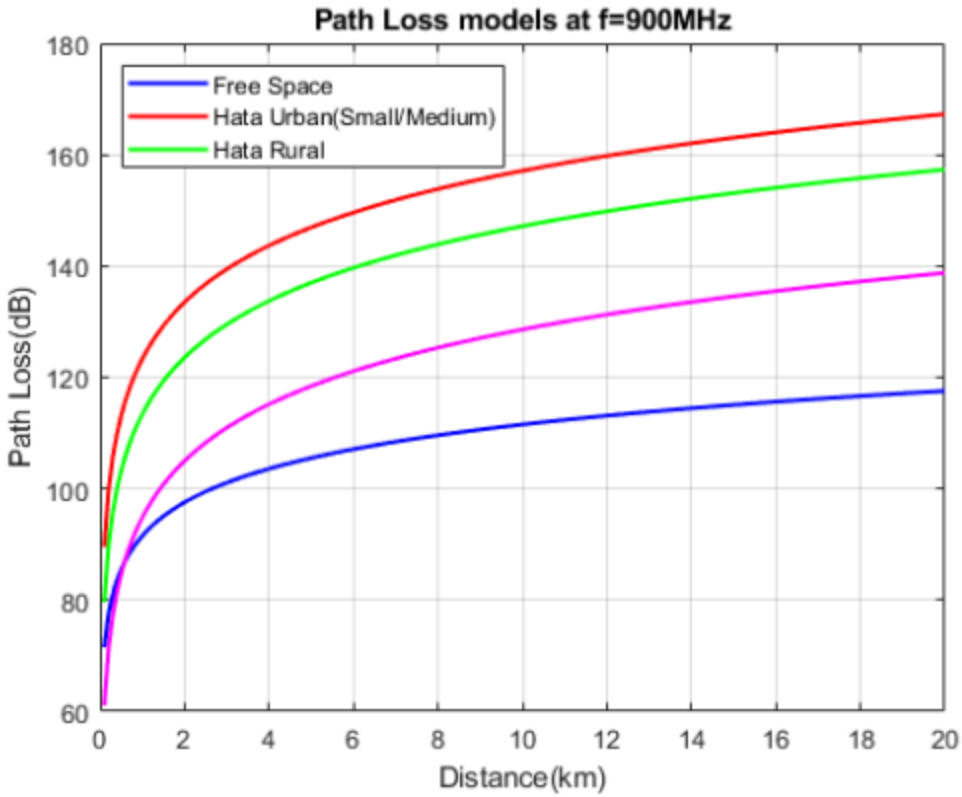
```
%23A91A0457
%Sk.Dilwar
%ECE-A
%03/09/2025
clc;clear;close all;
theta=linspace(0,180,361);%Angle in Degrees
Svv=abs(cosd(theta)).^2;%Co-pol(Vertical to Vertical)
Shv=abs(sind(theta)).^2*0.2;%Cross-pol(Vertical to Horizontal)
%Similarly,If you have Horizontal Tx
Shh=abs(cosd(theta)).^2;%Co-pol(Horizontal to Horizontal)
Svh=abs(sind(theta)).^2*0.9;%Cross-pol(Horizontal to Vertical)
XPD_v=10*log10(Svv./Shv);%For Vertical Polarization
XPD_h=10*log10(Shh./Svh);%For Horizontal Polarization
%Plot Results
figure;
subplot(2,2,1);
plot(theta,10*log10(Svv),'b','LineWidth',1.5);hold on;
plot(theta,10*log10(Shv),'r--','LineWidth',1.5);
xlabel('Angle(degrees)');ylabel('Power(dB)');
title('Vertical Transmit:Co-pol vs Cross-pol');
legend('Co-pol(Svv)','Cross-pol(Shv)');grid on;
subplot(2,2,2);
plot(theta,XPD_v,'k','LineWidth',1.5);
xlabel('Angle(degrees)');ylabel('XPD(dB)');
title('Cross-Polarization Discrimination(Vertical Tx)');grid on;
subplot(2,2,3);
plot(theta,10*log10(Shh),'b','LineWidth',1.5);hold on;
plot(theta,10*log10(Svh),'r--','LineWidth',1.5);
xlabel('Angle(degrees)');ylabel('Power(dB)');
title('Horizontal Transmit:Co-pol vs Cross-pol');
legend('Co-pol(Shh)','Cross-pol(Svh)');grid on;
subplot(2,2,4);
plot(theta,XPD_h,'k','LineWidth',1.5);
xlabel('Angle(degrees)');ylabel('XPD(dB)');
title('Cross-Polarization Discrimination(Horizontal Tx)');grid on;
```



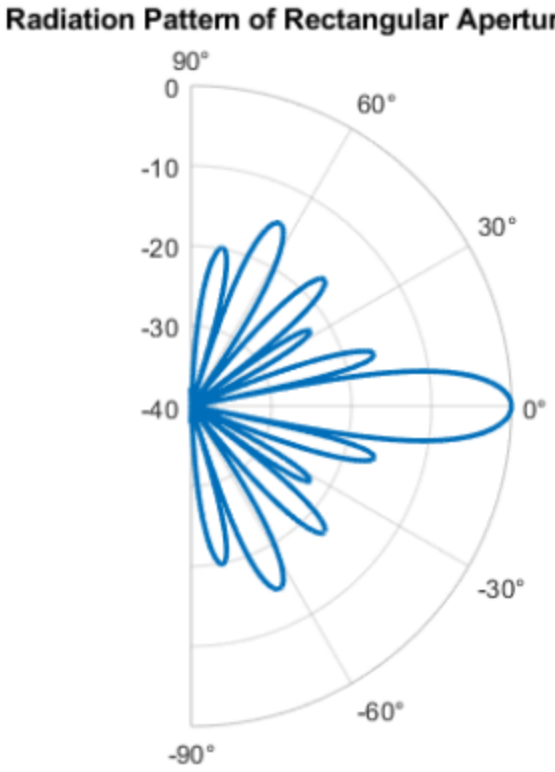
Published with MATLAB® R2023a

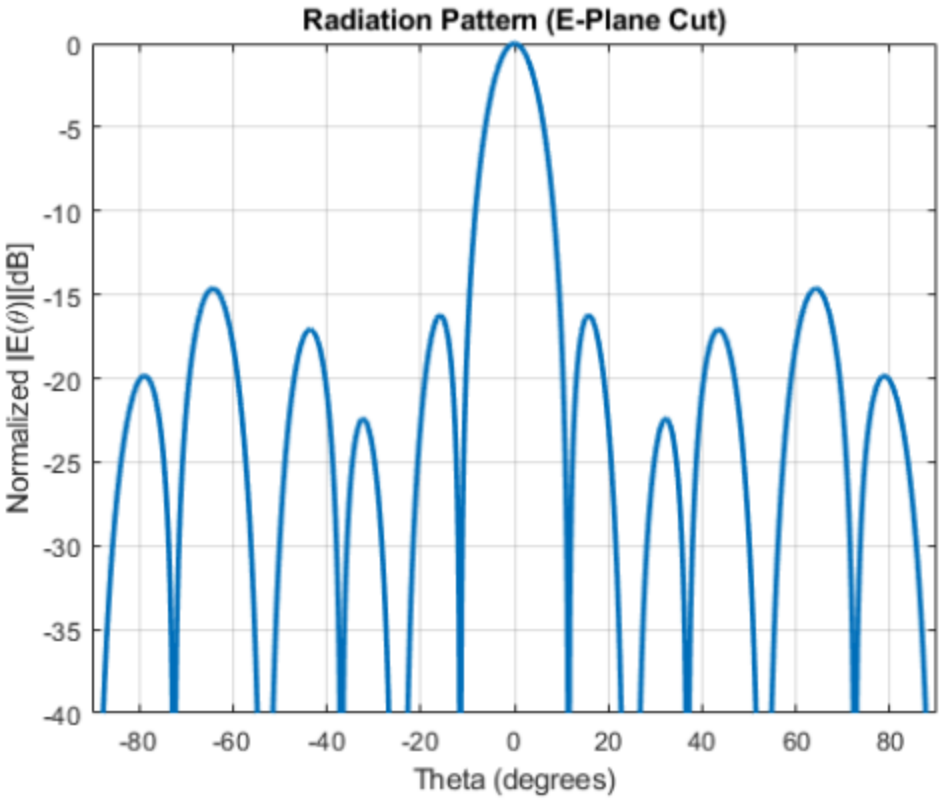
```
%23A91A0457
%Sk.Dilwar
%ECE-A
%10/09/2025
clc;
clear all;
close all;
f=900; %Frequency in MHz
d=0.1:0.1:20; %Distance km
hb=50; %Base Station Antenna Height(m)
hm=1.5; %Mobile Antenna Height(m)
%Free Space Path Loss(FSPL)
%FSPL Formula in dB: 32.45+20*log10(f)+20*log10(d)
PL_fs=32.45+20*log10(f)+20*log10(d);
%Hata Mode(Urban-Small/Medium City)
%Correction Factor for Mobile Antenna Height
a_hm=(1.1*log10(f)-0.7)*hm-(1.56*log10(f)-0.8);
%Hata Urban Path Loss
PL_hata_urban=69.55+26.16*log10(f)-13.82*log10(hb)-a_hm
+(44.9-6.55*log10(hb))*log10(d);
%Suburban Correction
PL_suburban=PL_hata_urban-2*(log10(f/28))^2-5.4;
%Rural(Open Area) Correction
PL_rural=PL_hata_urban-4.78*(log10(f))^2+18.33*log10(f)-40.94;
%Plot Results
figure;
plot(d,PL_fs,'b','LineWidth',1.5);
hold on;
plot(d,PL_hata_urban,'r','LineWidth',1.5);
plot(d,PL_suburban,'g','LineWidth',1.5);
plot(d,PL_rural,'m','LineWidth',1.5);
grid on;
xlabel('Distance(km)');
ylabel('Path Loss(dB)');
title(['Path Loss models at f=', num2str(f),'MHz']);
legend('Free Space','Hata Urban(Small/Medium)','Hata
 Rural','Location','northwest');
```



Published with MATLAB® R2023a

```
%23A91A0457
%Sk.Dilwar
%ECE-A
%17/09/2025
clc;clear;close all;
lambda=0.03; %Wavelength(m)
k=2*pi/lambda; %Wave Number
a=0.15; %Aperture Width(m)(Along x-axis)
b=0.10; %Aperture Height(m)(Along y-axis)
theta=linspace(-pi/2,pi/2,1000); %Observation Angle(Elevation)
phi=0; %Azimuth Angle Fixed
%Array Factor
E_theta=(sin((k*a/2)*sin(theta))./
((k*a/2)*sin(theta))).*(sin((k*b/2)*cos(theta))./((k*b/2)*cos(theta)));
%Normalize Pattern
E_theta_dB=20*log10(abs(E_theta)/max(abs(E_theta)));
%Plot Radiation Pattern
figure;
polarplot(theta,E_theta_dB,'LineWidth',2);
title('Radiation Pattern of Rectangular Aperture Antenna');
thetalim([-90 90]);
rlim([-40 0]);
grid on;
%Cartesian Plot
figure;
plot(rad2deg(theta),E_theta_dB,'LineWidth',2);
xlabel('Theta (degrees)');
ylabel('Normalized |E(\theta)|[dB]');
title('Radiation Pattern (E-Plane Cut)');
grid on;
axis([-90 90 -40 0]);
```


Radiation Pattern of Rectangular Aperture Antenna
90°
0
60°
-10
30°
-20
-30
-40
0°
-30°
-60°
-90°


Radiation Pattern (E-Plane Cut)
0
-5
-10
-15
-20
-25
-30
-35
-40
Normalized |E(θ)|[dB]
-80
-60
-40
-20
0
20
40
60
80
Theta (degrees)

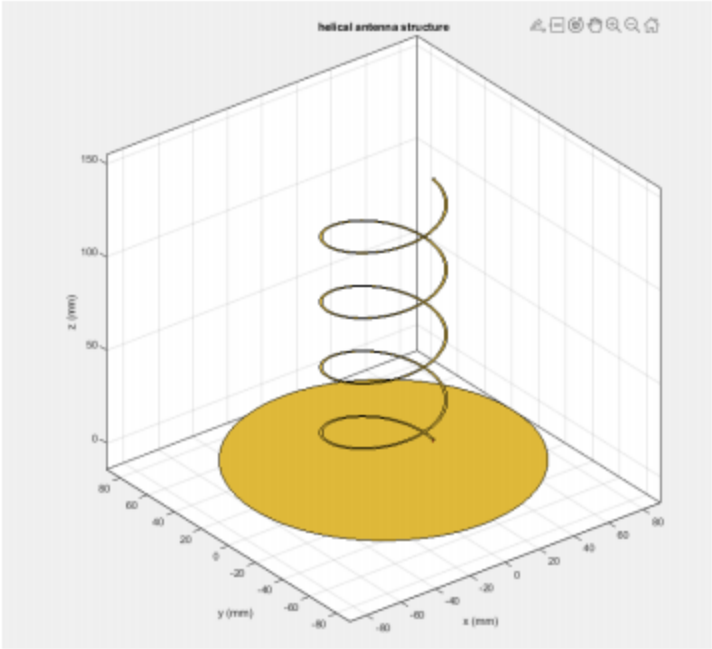
EXPERIMENT-10

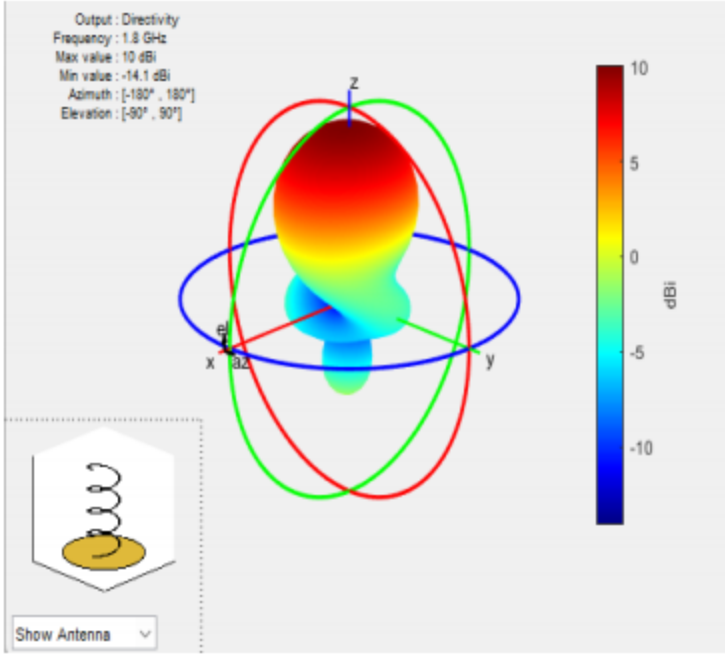
NAME:Sk.Dilwar

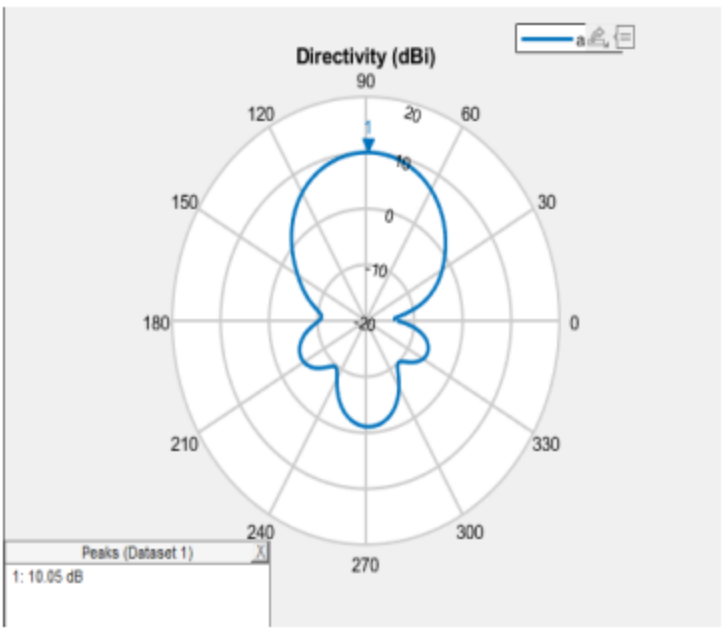
ROLL NO:23A91A0457

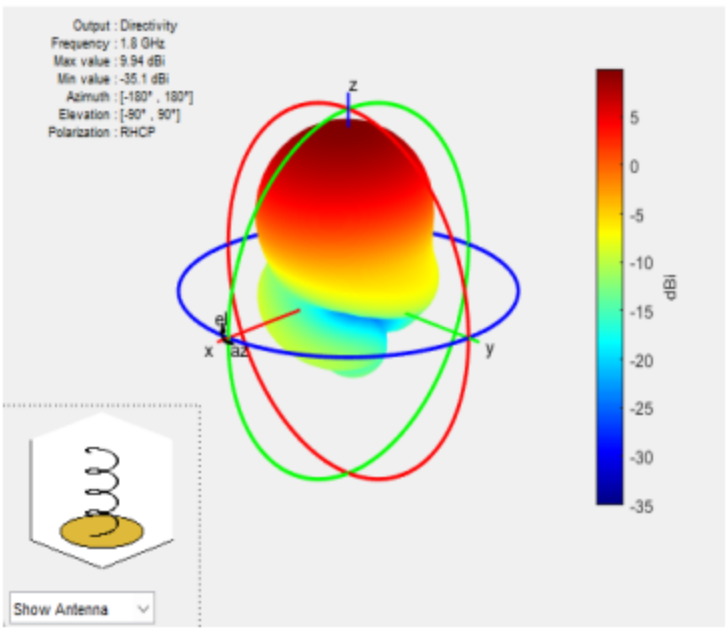
```
fc=1.8e9;
radius = 28e-3;
width = 1.2e-3;
turns = 4;
spacing = 35e-3;
gndRadius = 75e-3;
hx = helix(Radius=radius,Width = width,Turns = turns,...
    Spacing = spacing,GroundPlaneRadius=gndRadius);
figure;
show(hx);
title('helical antenna structure');
figure;
pattern(hx,fc);
title(['3D Radiation pattern at',num2str(fc/1e9),'GHz']);
figure;
pattern(hx,fc,0,1:1:360);
title(['XZ-plane Radiation Pattern at',num2str(fc/1e9),'GHz']);
figure;
pattern(hx,fc,Polarization="RHCP");
title(['RHCP Radiation pattern at',num2str(fc/1e9),'GHz']);
D = pattern(hx,fc,0,90);
disp(['Peak Directivity at',num2str(fc/1e9),'GHz',num2str(D),'dBi']);
figure;
pattern(hx,fc,Type="gain");
title('Gain pattern');
f_range = (1.7e9:1e7:2.2e9);
s_params=sparameters(hx,f_range);
figure;
smithplot(s_params);
title('S11 on Smith Chart');
figure;
rfplot(s_params);
title('S11(Return Loss)');
figure;
vswr (hx,f_range);
grid on;
title('VSWR vs. Frequency');
xlabel('Frequency(GHz)');
ylabel('VSWR');
```

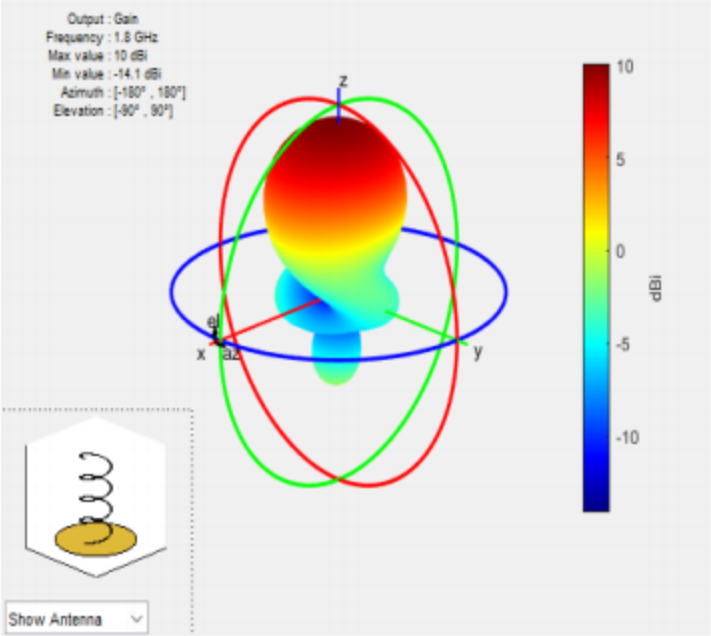
Peak Directivity at1.8GHz10.0444dBi

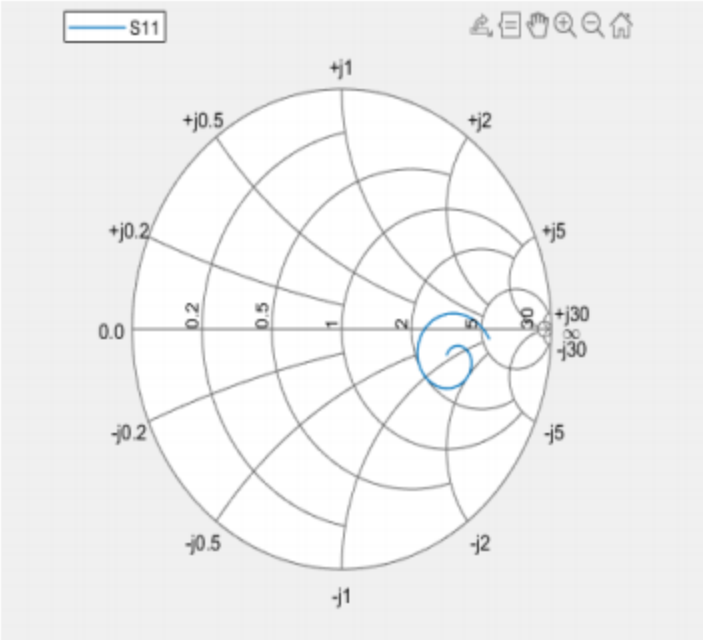

helical antenna structure
z (mm)
y (mm)
x (mm)

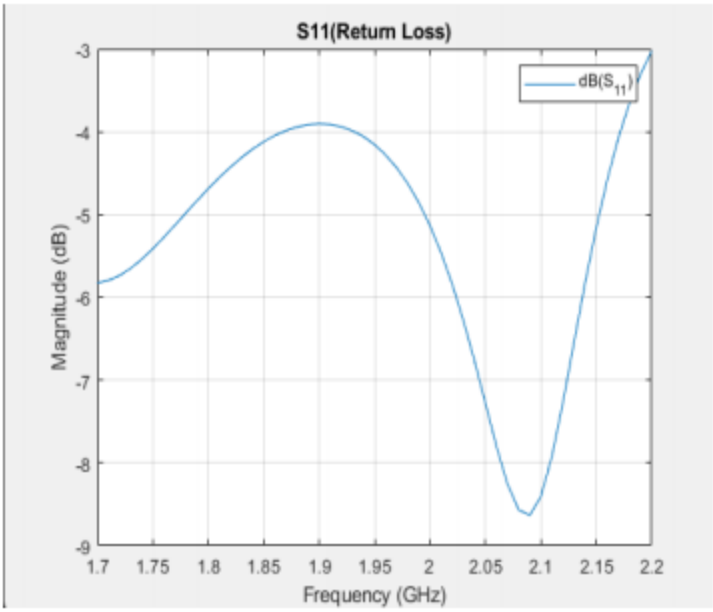

Output : Directivity
Frequency : 1.8 GHz
Max value : 10 dBi
Min value : -14.1 dBi
Azimuth : [-180° , 180°]
Elevation : [-90° , 90°]
z
x
y
el
az
10
5
0
-5
-10
dBi
Show Antenna

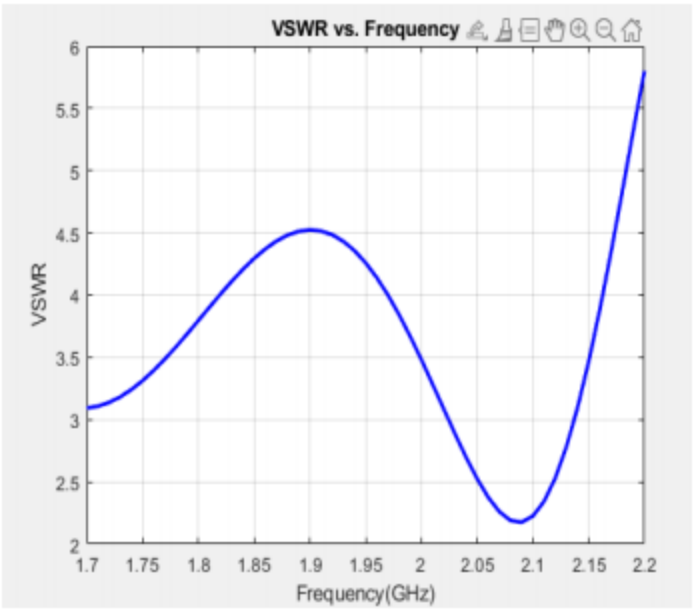

Directivity (dBi)
90
120
60
150
30
180
0
210
330
240
300
270
20
10
0
-10
-20
Peaks (Dataset 1)
1: 10.05 dB


Output : Directivity
Frequency : 1.8 GHz
Max value : 9.94 dBi
Min value : -35.1 dBi
Azimuth : [-180° , 180°]
Elevation : [-90° , 90°]
Polarization : RHCP
z
x
y
el
az
5
0
-5
-10
-15
-20
-25
-30
-35
dBi
Show Antenna


Output : Gain
Frequency : 1.8 GHz
Max value : 10 dBi
Min value : -14.1 dBi
Azimuth : [-180° , 180°]
Elevation : [-90° , 90°]
z
x
y
10
5
0
-5
-10
dBi
Show Antenna


S11
+j1
+j0.5
+j2
+j0.2
+j5
0.0
0.2
0.5
1
2
5
50
+j30
∞
-j30
-j0.2
-j5
-j0.5
-j2
-j1


S11(Return Loss)
dB(S11)
Magnitude (dB)
-3
-4
-5
-6
-7
-8
-9
1.7
1.75
1.8
1.85
1.9
1.95
2
2.05
2.1
2.15
2.2
Frequency (GHz)

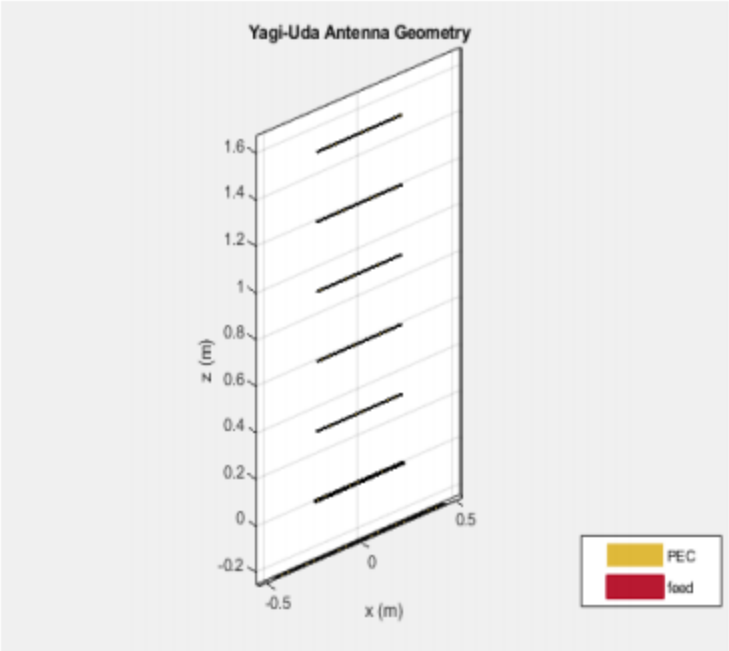

VSWR vs. Frequency
VSWR
6
5.5
5
4.5
4
3.5
3
2.5
2
1.7
1.75
1.8
1.85
1.9
1.95
2
2.05
2.1
2.15
2.2
Frequency(GHz)

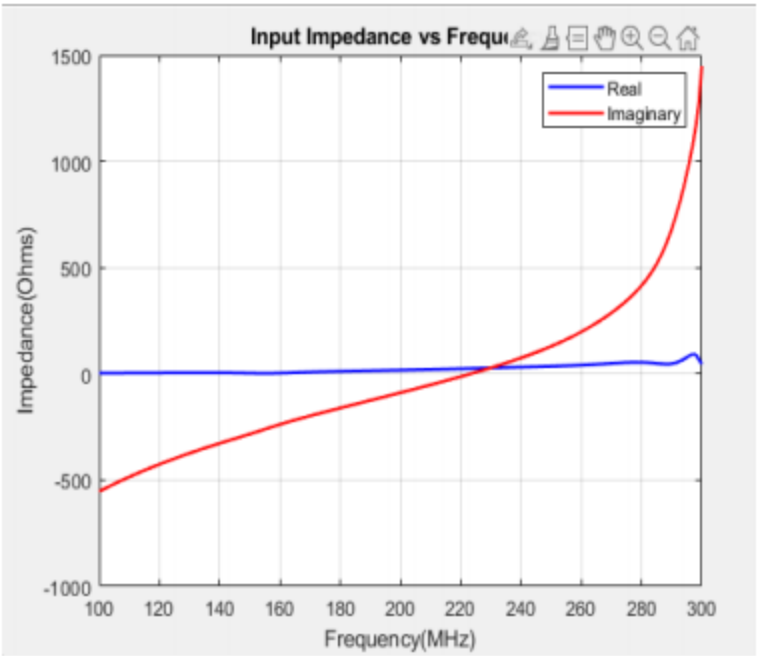
EXPERIMENT-11

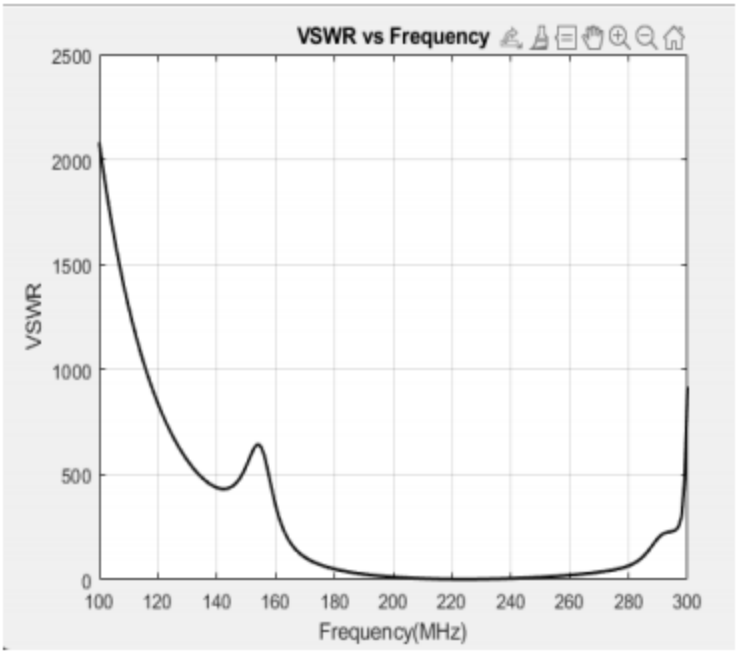
NAME:Sk.Dilwar

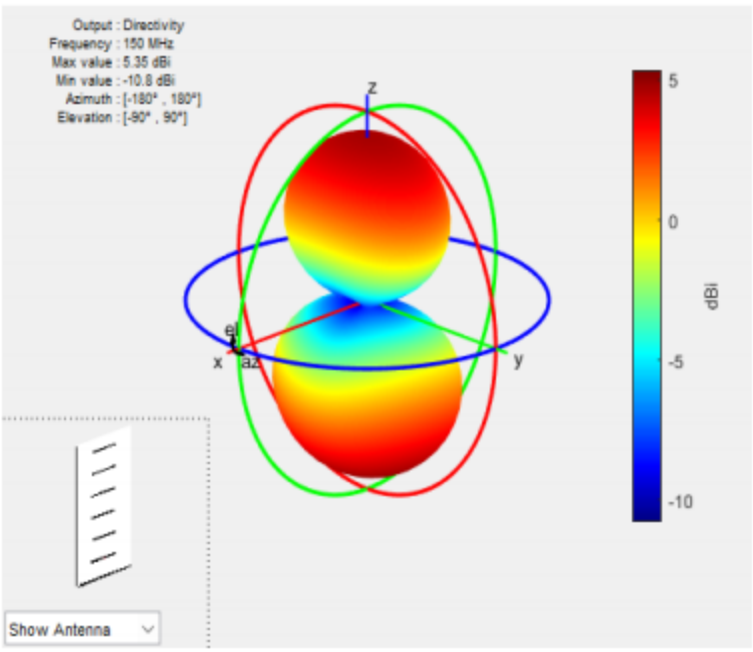
ROLL NO:23A91A0457

```
clc;
clear;
close all;
yagi=yagiUda;
yagi.NumDirectors=5;
yagi.ReflectorLength=0.9;
yagi.ReflectorSpacing=0.25;
yagi.DirectorLength=0.45;
yagi.DirectorSpacing=0.3;
yagi.Exciter.Length=0.47;
yagi.Exciter.Width=0.01;
figure;
show(yagi);
title('Yagi-Uda Antenna Geometry');
freq=linspace(100e6,300e6,201);
z=impedance(yagi,freq);
figure;
plot(freq/1e6,real(z),'b','LineWidth',1.5);hold on;
plot(freq/1e6,imag(z),'r','LineWidth',1.5);
xlabel('Frequency(MHz)');
ylabel('Impedance(Ohms)');
legend('Real','Imaginary');
title('Input Impedance vs Frequency');
grid on;
s=sparameters(yagi,freq);
S11=rfparam(s,1,1);
vswrVals=vswr(S11);
figure;
plot(freq/1e6,vswrVals,'k','LineWidth',1.5);
xlabel('Frequency(MHz)');
ylabel('VSWR');
title('VSWR vs Frequency');
grid on;
freq0=150e6;
figure;
pattern(yagi,freq0);
title(['Radiation Pattern at',num2str(freq0/1e6),'MHz']);
boresightGain=pattern(yagi,freq0,0,0);
disp(['Gain
at',num2str(freq0/1e6),'MHz=',num2str(boresightGain,'%.2f'),'dBi']);
```


Yagi-Uda Antenna Geometry
z (m)
x (m)
PEC
feed


Input Impedance vs Frequ
Real
Imaginary
Impedance(Ohms)
Frequency(MHz)


VSWR vs Frequency
VSWR
Frequency(MHz)


Output : Directivity
Frequency : 150 MHz
Max value : 5.35 dBi
Min value : -10.8 dBi
Azimuth : [-180° , 180°]
Elevation : [-90° , 90°]
z
x
y
dBi
Show Antenna