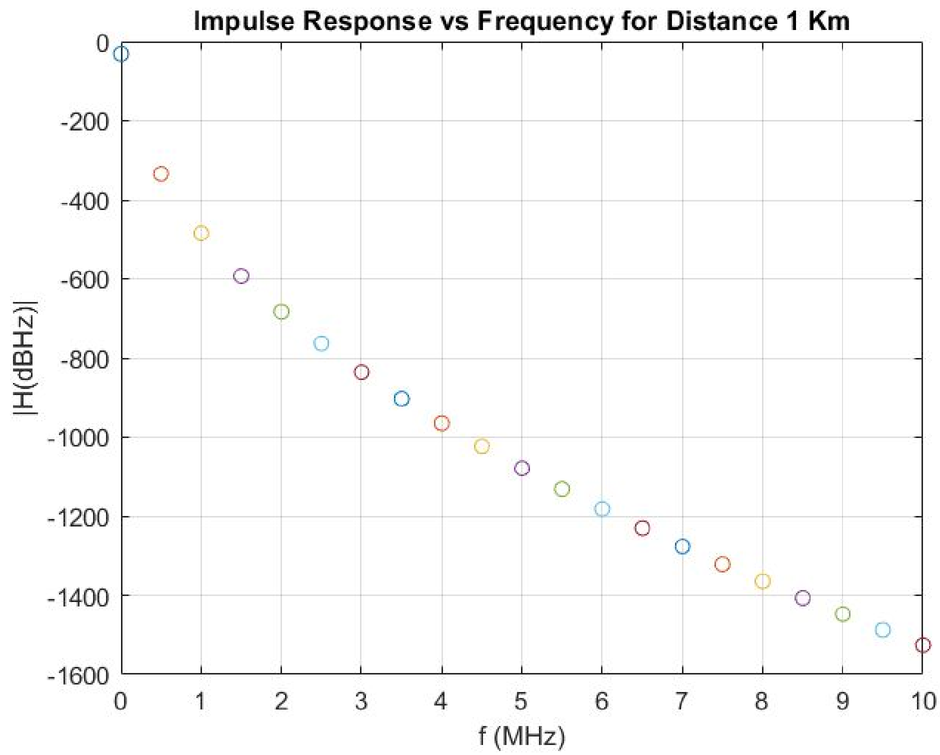
Question 1

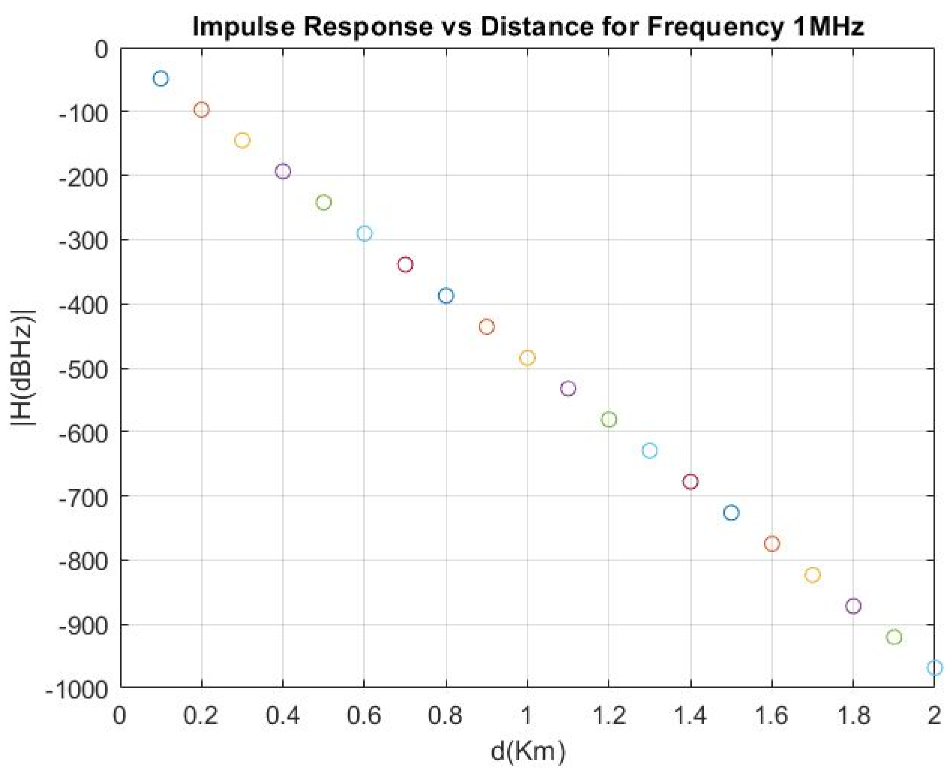
Code

```
%Parameters for 0.32mm wire
Roc = 409; ac = 0.3822; L0 = 607e-6; Linf = 500e-6; b = 5.269;
fm = 609000; Cinf = 40*10^-12; C0 = 0; Ce = 1; g0 = 0; ge = 1;

%for Fixed Frequency of 1MHz, Values of R, L, G and C and Gamma
f = 1e6; w = 2*pi*f;

R_f = power(power(Roc,4) + ac*f*f, 0.25);
L_f = (L0 + Linf*power(f/fm, b))/(1+power(f/fm, b));
G_f = g0*power(f, ge);
C_f = Cinf + C0*power(f, -Ce);

Y = power(((R_f + 1i*w*L_f)*(G_f + 1i*w*C_f)), 0.5);

%Studying Variation from distance 100m to 2000m
d0 = 100;
figure(1);

for c = 0:19
   d = d0 + c*100; %Incrementing Distance by 100m every iteration
   H_f = exp(-Y*d);
   H_dbHz = 10*log10(abs(H_f));
   plot(d/1000, H_dbHz, 'O')
   hold all;
end

xlim([0 2]);
ylim([-1000 0]);
title('Impulse Response vs Distance for Frequency 1MHz')
xlabel('d(Km)')
ylabel('|H(dBHz)|')
hold off;
grid on;

%For Fixed distance of 1000m, studying variation with Frequency
f0 = 1;
f_int = 500;
d = 1000;
```

```
figure(2);

for c = 0:200
   f = f0*1000 + c*f_int*1000; %Incrementing by 500KHz every iteration

   %Updating Values of R, L, G, C and Y
   w = 2*pi*f;

   R_f = power(power(Roc,4) + ac*f*f, 0.25);
   L_f = (L0 + Linf*power(f/fm, b))/(1+power(f/fm, b));
   G_f = g0*power(f, ge);
   C_f = Cinf + C0*power(f, -Ce);

   Y = power(((R_f + 1i*w*L_f)*(G_f + 1i*w*C_f)), 0.5);
   H_f = exp(-Y*d);
   H_dbHz = 10*log10(abs(H_f));

   plot(f/1e6, H_dbHz, 'O')
   hold all;
end

xlim([0 10]);
ylim([-1600 0]);
title('Impulse Response vs Frequency for Distance 1 Km')
xlabel('f (MHz)')
ylabel('|H(dBHz)|')
hold off;
grid on;
```

Plots


Impulse Response vs Frequency for Distance 1 Km
0
-200
-400
-600
-800
-1000
-1200
-1400
-1600
|H(dBHz)|
0
1
2
3
4
5
6
7
8
9
10
f (MHz)


Impulse Response vs Distance for Frequency 1MHz
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
-1000
|H(dBHz)|
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
d(Km)

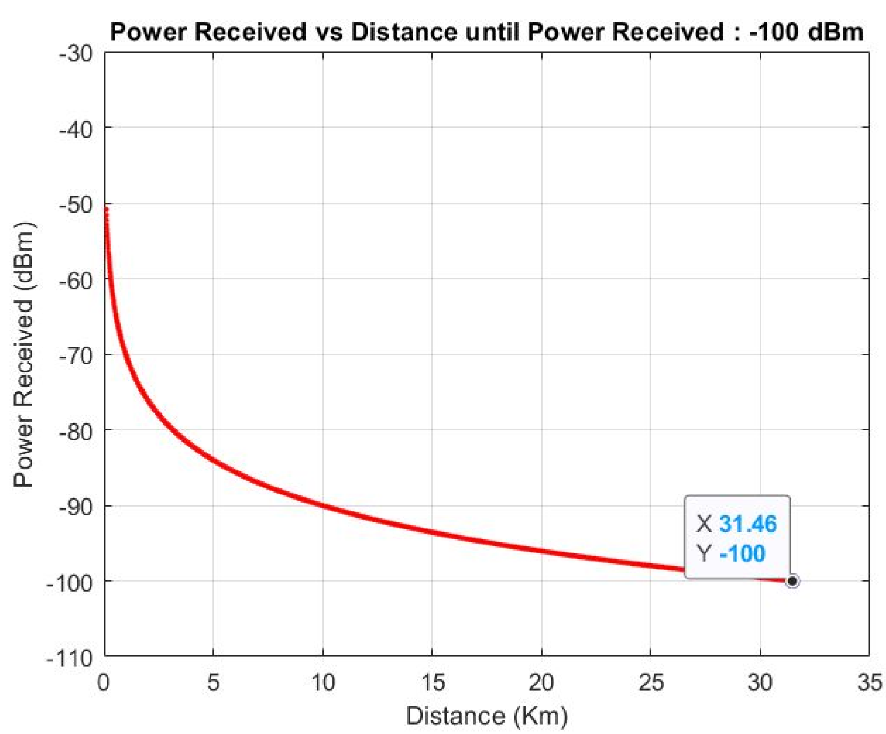
Question 2

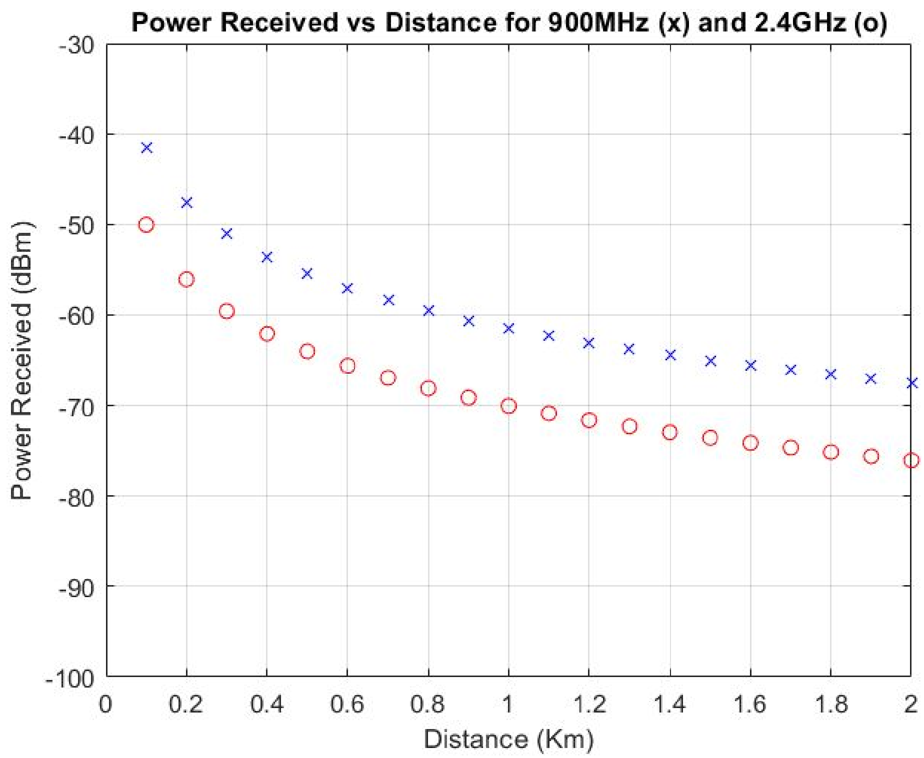
Code

```
%Parameters provided in Task
P_t = 1; G_t = 1; G_r = 1; f_1 = 900e6; f_2 = 2.4e9;
lambda_1 = 3e8/f_1; lambda_2 = 3e8/f_2;

%Studying Variation of Power Received with Distance with Fixed Frequencies
d0 = 100;

%Frequency 1: 900 MHz
figure(1);
for c = 0:19
   d = d0 + c*100; %Incrementing distance by 100m every iteration

   %Updating Power Received
   P_r =(P_t*G_t*G_r*lambda_1*lambda_1)/(power(4*pi*d, 2)) ;
   P_r_dBm = 10*log10(P_r*1000);

   plot(d/1000, P_r_dBm, 'b-x', 'MarkerEdgeColor','b')
   hold all;
end
%Frequency 2: 2.6 GHz
for c = 0:19
   d = d0 + c*100;  %Incrementing distance by 100m every iteration

   %Updating Power Received
   P_r =(P_t*G_t*G_r*lambda_2*lambda_2)/(power(4*pi*d, 2)) ;
   P_r_dBm = 10*log10(P_r*1000);

   plot(d/1000, P_r_dBm, 'O','MarkerEdgeColor','r')
   hold all;
end
xlabel('Distance (Km)')
ylabel('Power Received (dBm)')
ylim([-100 -30]);
title('Power Received vs Distance for 900MHz (x) and 2.4GHz (o)')
hold off;
grid on;

%Extra Task
```

```
%Frequency: 2.4 GHz
lambda_x = 3e8/2.4e9;
figure(2);
P_r_dBm = -24;
while P_r_dBm > -100
    d0 = d0 + 10;  %Incrementing distance by 100m every iteration
    %Updating Power Received
    P_r =(P_t*G_t*G_r*lambda_x*lambda_x)/(power(4*pi*d0, 2)) ;
    P_r_dBm = 10*log10(P_r*1000);
    plot(d0/1000, P_r_dBm, '.','MarkerEdgeColor','r')
    hold all;
end
xlabel('Distance (Km)')
ylabel('Power Received (dBm)')
ylim([-110 -30]);
title('Power Received vs Distance until Power Received : -100 dBm')
plot(d0/1000, P_r_dBm, 'o-','MarkerFaceColor','yellow','MarkerEdgeColor','blue');
%Distance for Power Received: -100 dBm is 31.46km
grid on;
```

Plots




Power Received vs Distance for 900MHz (x) and 2.4GHz (o)
Power Received (dBm)
Distance (Km)
-30
-40
-50
-60
-70
-80
-90
-100
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2