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Wireless Communications

Problem 2

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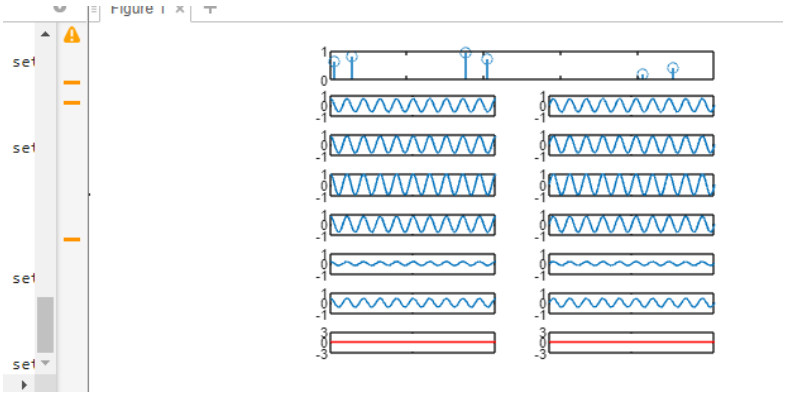
Code 1:

```
a=[0.6154 0.7919 0.9218 0.7382 0.1763 0.4057];
tau=[0.0099 0.0579 0.3529 0.4103 0.8132 0.8936];

t = 0:1/100:2;
w = 5;
N_path = length(tau);

exp_iwt_sum = zeros(1,length(t));

subplot(N_path + 2,2,[1 2]);
stem(tau,a);set(gca,'ytick',[0 1]);set(gca,'xticklabel',[]);

for d=1:1:N_path

    exp_iwt = a(d) .* exp(j .* 2 .* pi .* w .* (t .- tau(d)) );
    exp_iwt_sum += exp_iwt;

    subplot(N_path + 2,2,2*d+1);
    plot(t,real(exp_iwt)); xlim([0 2]);ylim([-1 1]); set(gca,'xticklabel',[]);
    set(gca,'ytick',[-1 0 1]);
    subplot(N_path + 2,2,2*d+2);
    plot(t,imag(exp_iwt)); xlim([0 2]);ylim([-1 1]); set(gca,'xticklabel',[]);
    set(gca,'ytick',[-1 0 1]);

end

d = N_path + 1;
subplot(N_path + 2,2,2*d+1);
plot(t,real(exp_iwt_sum),'r-'); xlim([0 2]);ylim([-3 3]); set(gca,'xticklabel',[]);
set(gca,'ytick',[-3 0 3]);
subplot(N_path + 2,2,2*d+2);
plot(t,imag(exp_iwt_sum),'r-'); xlim([0 2]);ylim([-3 3]); set(gca,'xticklabel',[]);
set(gca,'ytick',[-3 0 3]);
```

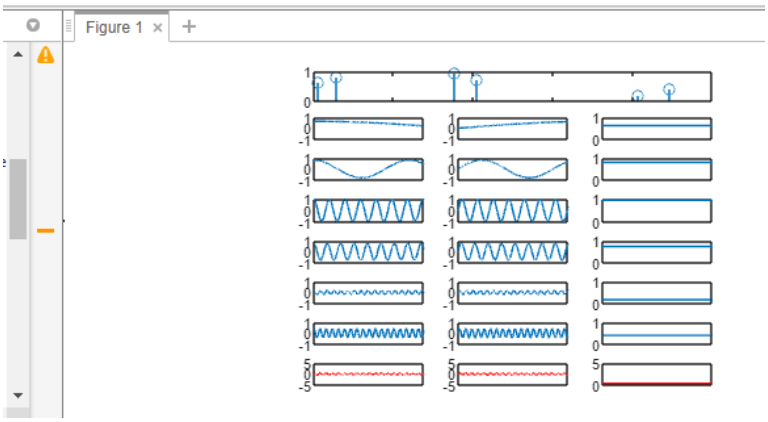
Output1:



Code 2:

```
a=[0.6154 0.7919 0.9218 0.7382 0.1763 0.4057];
tau=[0.0099 0.0579 0.3529 0.4103 0.8132 0.8936];

w = 0:pi/100:40*pi;
wmax = max(w);

N_path = length(tau);

Hw_sum = zeros(1,length(w));

subplot(N_path + 2,3,[1 3]);
stem(tau,a);set(gca,'ytick',[0 1]);set(gca,'xticklabel',[]);

for d=1:1:N_path
        Hw = a(d) .* exp(j * w * tau(d) );
        Hw_sum += Hw;

        subplot(N_path + 2,3,3*d+1);
        plot(w,real(Hw)); xlim([0 wmax]);ylim([-1 1]); set(gca,'xticklabel',[]);
        set(gca,'ytick',[-1 0 1]);
        subplot(N_path + 2,3,3*d+2);
        plot(w,imag(Hw)); xlim([0 wmax]);ylim([-1 1]); set(gca,'xticklabel',[]);
        set(gca,'ytick',[-1 0 1]);
        subplot(N_path + 2,3,3*d+3);
        plot(w,abs(Hw)); xlim([0 wmax]);ylim([0 1]); set(gca,'xticklabel',[]);
        set(gca,'ytick',[0 1]);
end

d = N_path + 1;
subplot(N_path + 2,3,3*d+1);
plot(w,real(Hw_sum),'r-'); xlim([0 wmax]);ylim([-5 5]); set(gca,'xticklabel',[]);
set(gca,'ytick',[-5 0 5]);
subplot(N_path + 2,3,3*d+2);
plot(w,imag(Hw_sum),'r-'); xlim([0 wmax]);ylim([-5 5]); set(gca,'xticklabel',[]);
set(gca,'ytick',[-5 0 5]);
subplot(N_path + 2,3,3*d+3);
plot(w,abs(Hw_sum),'r-'); xlim([0 wmax]);ylim([0 5]); set(gca,'xticklabel',[]);
set(gca,'ytick',[0 5]);
```

Output2:

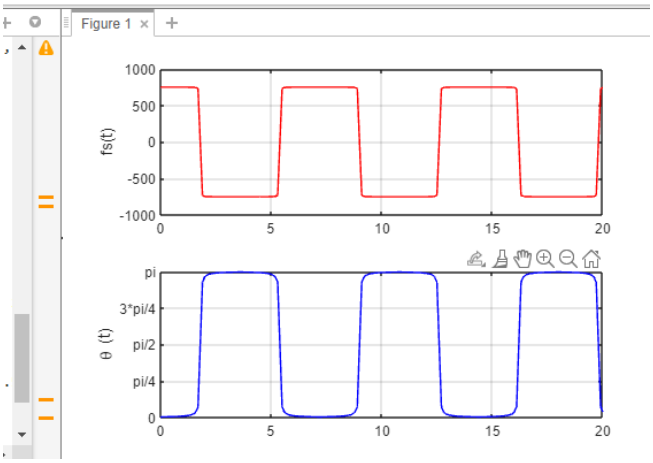


Code 3:

```
fd = 750;
 Dmin = 2; % in meter
 Ds = 300; % in meter
 v = 300 * 1000/3600; % in m/s


 tmin = 0;
 tmax = 20;
 tstep = 0.1;
 fs = [];
 th = [];

 for t = tmin:tstep:tmax
    costh =  CosTh(t,Dmin,Ds,v);
    y = fd .* CosTh(t,Dmin,Ds,v);
    fs = [fs y];
    th = [th acos(costh)];
 end

 subplot(2,1,1);
 plot(tmin:tstep:tmax,fs,'r-');
 xlim([tmin tmax]); ylim([-1000 1000]);
 ylabel('fs(t)');
 grid();

 subplot(2,1,2);
 plot(tmin:tstep:tmax,th,'b-');
 xlim([tmin tmax]);
 ylim([0 pi()]);
 set(gca,'ytick',[0 pi/4 pi/2 3*pi/4 pi]);
 set(gca,'yticklabel',{'0', 'pi/4', 'pi/2', '3*pi/4', 'pi'});
 ylabel('\theta (t)');
 grid();

end
```

```
function y = CosTh(t, Dmin, Ds, v)
    if (t >= 0) && ( t <= Ds / v)
        y = (Ds ./ 2 - v .* t)/sqrt(Dmin .^ 2 + (Ds ./ 2 - v .* t)^2);
    elseif (t > Ds / v) && ( t <= (2 .* Ds ./ v))
        y = (-1.5 .* Ds + v .* t)/sqrt(Dmin .^ 2 + (-1.5 .* Ds + v .* t)^2);
    elseif (t > 2 .* Ds ./ v)
        y  = CosTh(mod(t, 2 .* Ds ./ v),Dmin, Ds, v);
    end
end
```

Output3:



END