ECEN 220
Lab Report 2 - Fourier Series

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1 Harmonic Convergence

```
clear
clc

T = 3;
t = 0:0.01:3;
x = exp(-t);
w = (2.*pi)./T;
K = [1 5 10 30];
mag = [];
phs = [];

subplot(4,1,[1 2]);

plot(t,x);
hold on;
for n=1:length(K)
    hat = 0;
    for k=-K(n):K(n)
        F = @(t)(exp(-t).*exp(-1j
            .*k.*w.*t));
        ak = 1/T.*integral(F,0,T);
        hat = hat + (ak .* exp(1j
            .*k.*w.*t));

        if K(n) == 10
            mag = [mag, abs(ak)];
            phs = [phs, rad2deg(
                angle(ak))];
        end
    end
    plot(t,hat);
end
xlabel('t');
ylabel('x(t)');
legend('CT', 'K=1','K=5','K=10','K
    =30')
hold off;

p2 = subplot(4,1,3);
k10 = -10:10;
stem(k10, mag);
xlabel(p2,'k');
ylabel(p2,'mag');
legend(p2,'Magnitudes␣of␣a_k')
```

```
p3 = subplot(4,1,4);
k10 = -10:10;
stem(k10, phs);
xlabel(p3,'k');
ylabel(p3,'phase␣(deg)');
legend(p3,'Phases␣of␣a_k')
```

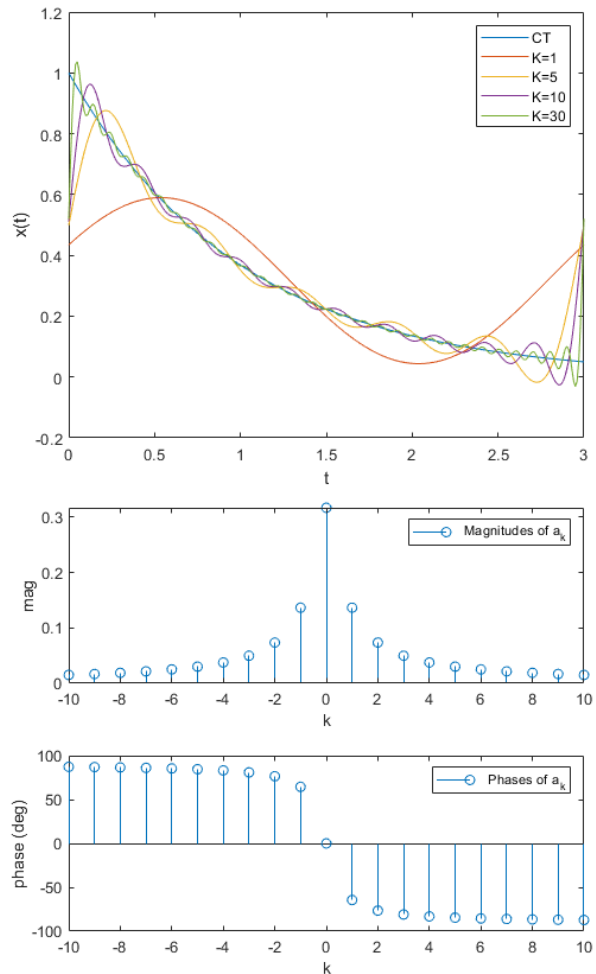

Figure 1: FS

2 Average Signal Power

```
clear
clc

T = pi;
t = 0:0.01:T;
w = (2.*pi)./T;
x = sin(t).*exp(-t);
K = 5

power_sum = 0;
for k=-K:K
        F = @(t)sin(t).*exp(-t).*
          exp(-1j.*k.*w.*t);
        ak = 1/T.*integral(F,0,T);

        power_sum = power_sum +
          abs(ak).^2;
end


F = @(t)abs(sin(t).*exp(-t)).^2;
power_integral = 1/T.*integral(F
   ,0,T);

power_sum
power_integral
```

```
K =

     5


power_sum =

    0.0397


power_integral =

    0.0397
```

Figure 2: SP