SS EXPERIMENT LAB 1

TITLE: Generation of basic signals using MATLAB

NAME: Yash Gupta

ROLL NO: S20200010234

SOFTWARE USED: MATLAB

OBSERVATION: In this lab, I learnt how to plot basic continuous and discrete signals and how to calculate its periodicity.

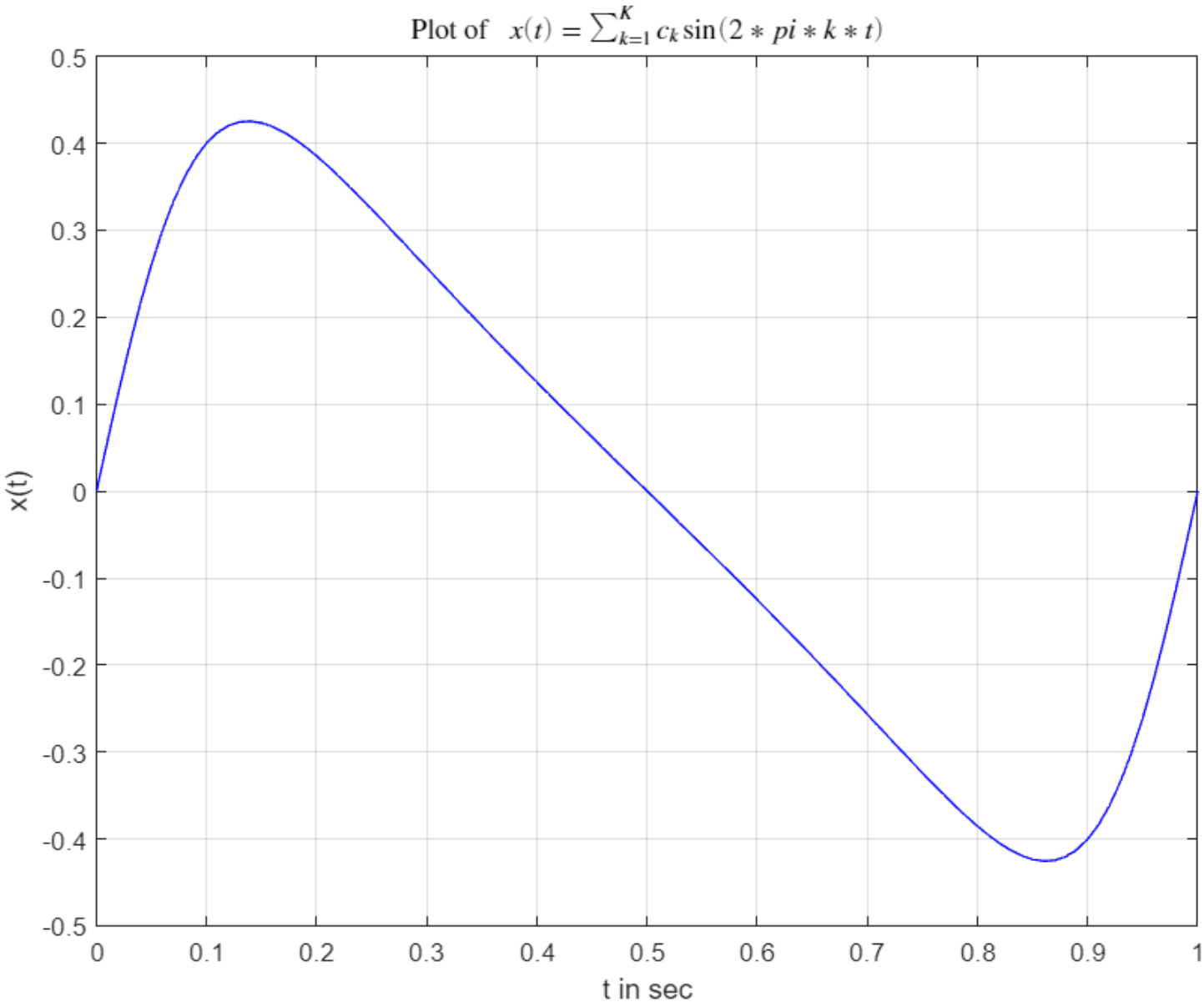
Q1.

Write a MATLAB script to generate the signal $x(t)$ expressed as

$$x(t) = \sum_{k=1}^{K} c_k \sin(2\pi k t)$$

Assume that $c_k = 1/e^k$.

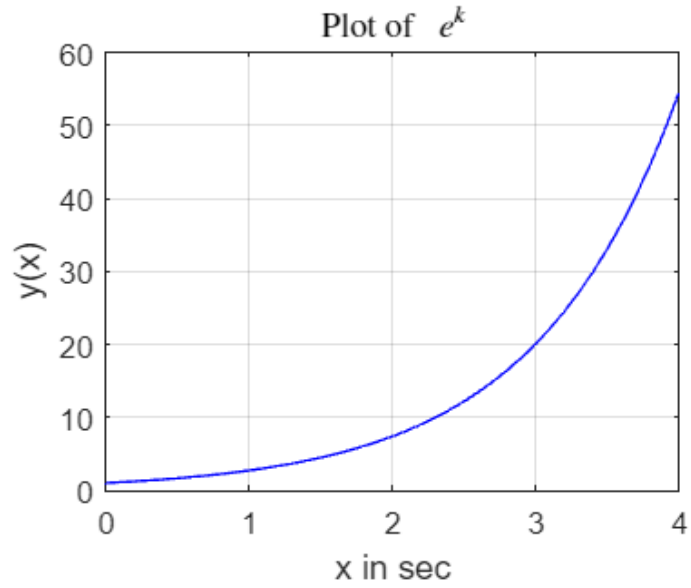
```
t=0:0.01:1;
K=10;
xt = zeros(1,length(t));
for k=1:K
    c=exp(-k);
    xt=xt+ c* sin(2*pi*k*t);
end
plot(t,xt,'b');
xlabel('t in sec');
ylabel('x(t)');
tx='Plot of $\ x(t)=\sum_{k=1}^K c_{k} \sin(2\ast pi \ast k \ast t)$';
title(tx, 'interpreter', 'latex'); % Title plot
grid on;
```

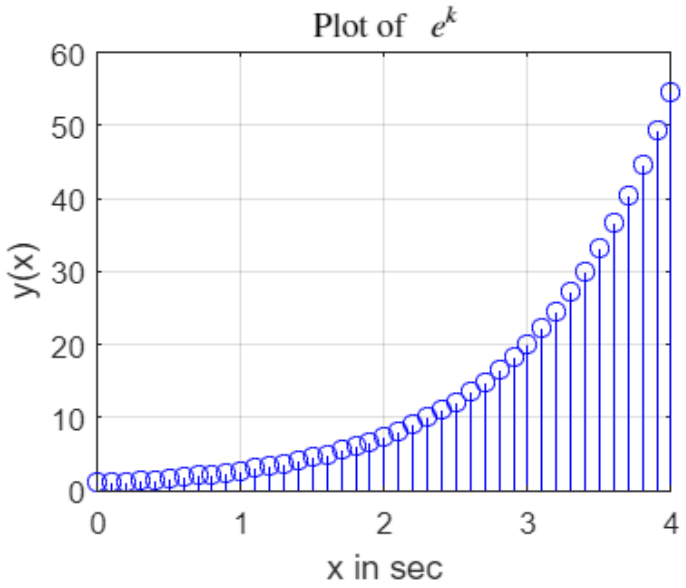

Plot of $x(t) = \sum_{k=1}^{K} c_k \sin(2 * pi * k * t)$
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
x(t)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
t in sec

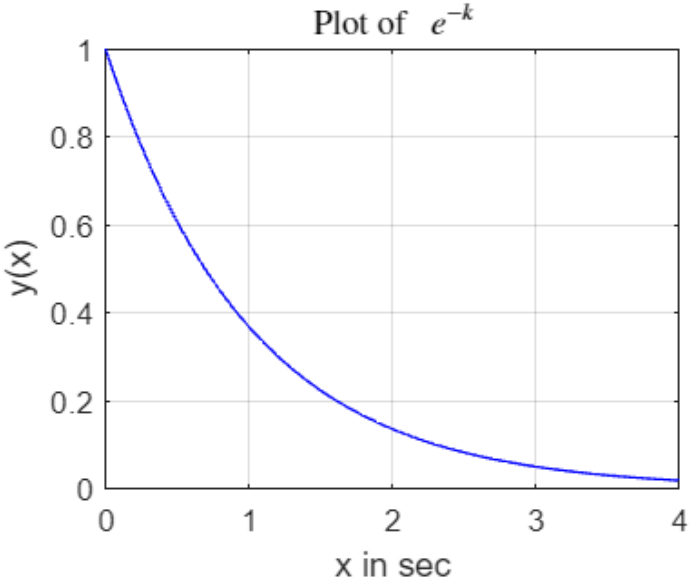
Q2.

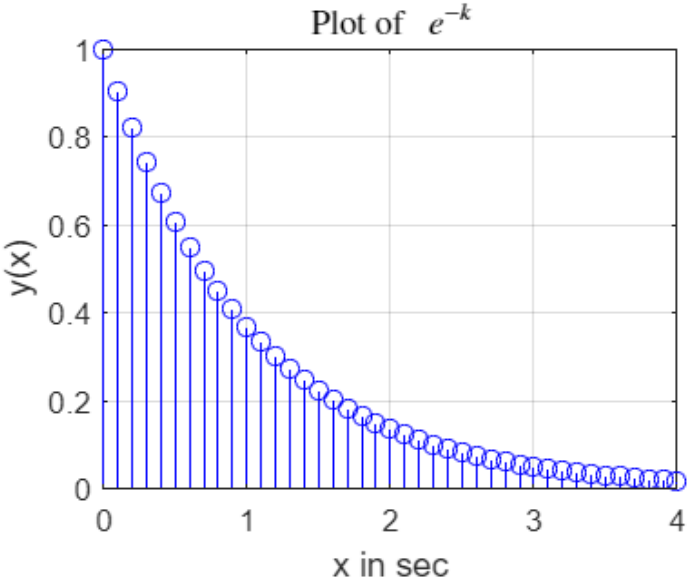
Write a MATLAB script to generate *exponential growing* and *decaying exponential signals* for the continuous and discrete-time.

```
x=0:0.1:4;
subplot(2,2,1);
y=exp(x);
plot(x,y,'b');
xlabel('x in sec');
ylabel('y(x)');
tx='Plot of $\ e^k $';
title(tx, 'interpreter', 'latex');
grid on;
subplot(2,2,2);
y=exp(x);
stem(x,y,'b');
xlabel('x in sec');
ylabel('y(x)');
tx='Plot of $\ e^k $';
title(tx, 'interpreter', 'latex');
grid on;
subplot(2,2,3);
y=exp(-x);
plot(x,y,'b');
xlabel('x in sec');
ylabel('y(x)');
tx='Plot of $\ e^{-k} $';
title(tx, 'interpreter', 'latex');
grid on;
subplot(2,2,4);
y=exp(-x);
stem(x,y,'b');
xlabel('x in sec');
ylabel('y(x)');
tx='Plot of $\ e^{-k} $';
title(tx, 'interpreter', 'latex');
```


Plot of e^k
y(x)
x in sec
0
10
20
30
40
50
60
0
1
2
3
4


Plot of e^k
y(x)
x in sec
0
10
20
30
40
50
60
0
1
2
3
4


Plot of e^{-k}
y(x)
x in sec
0
0.2
0.4
0.6
0.8
1
0
1
2
3
4


Plot of e^{-k}
y(x)
x in sec
0
0.2
0.4
0.6
0.8
1
0
1
2
3
4

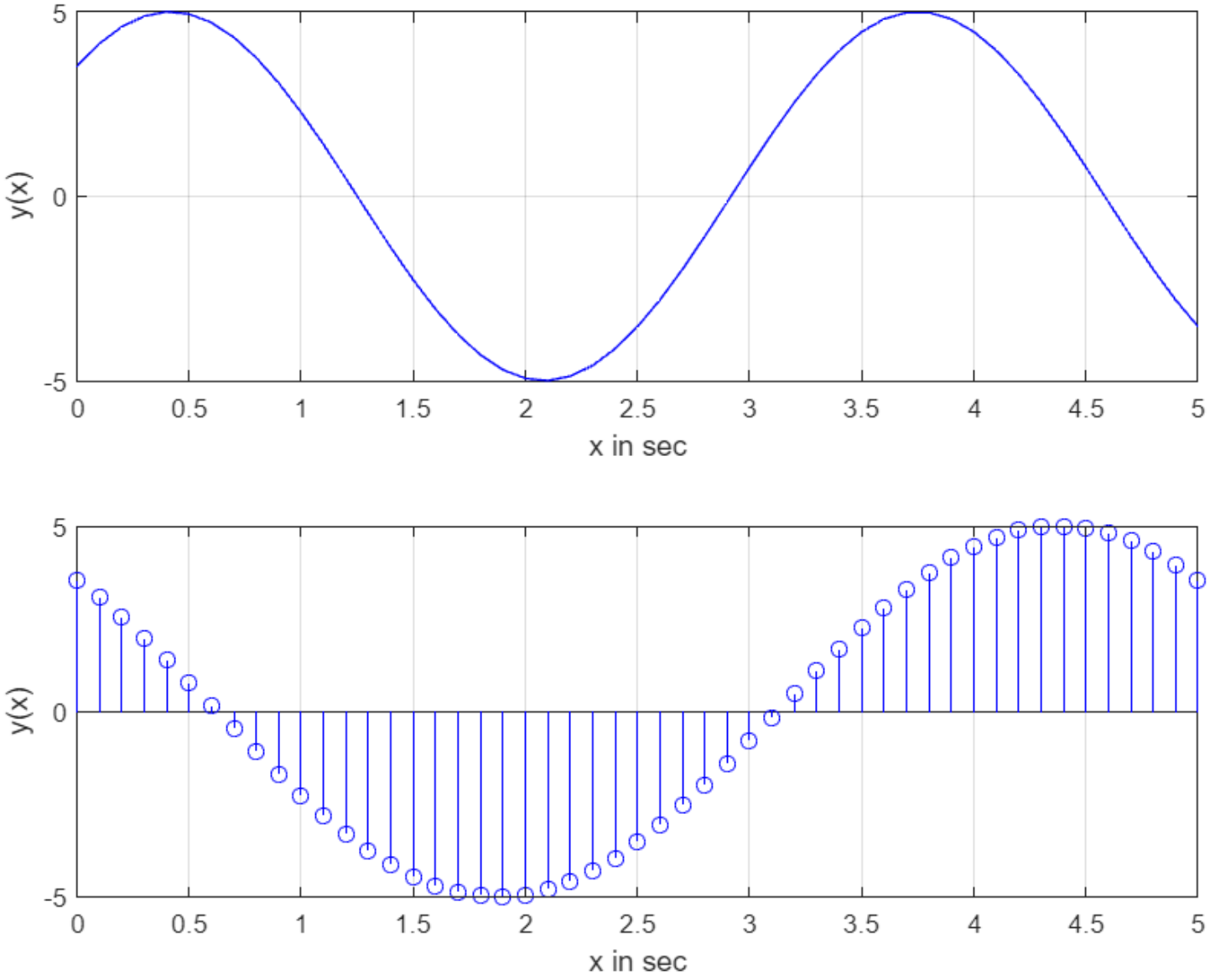
Q3.

Write a MATLAB script to generate the periodic sinusoid signal for the *continuous and discrete time* systems.

$$x(t) = A\sin(\Omega_0 t + \theta)\ ,\ \ assume\ T = 10/3,\ \ \theta = 45^{\circ}$$
$$x(n) = A\cos(\omega_0 t + \theta),\ assume\ T = 5,\quad \theta = 45^{\circ}$$

```
t=0:0.1:5;
A=5;
subplot(2,1,1);
T=10/3;
xt=A*sin(((2*pi)/T)* t+pi/4);
plot(t,xt,'b');
xlabel('x in sec');
ylabel('y(x)');
grid on;

subplot(2,1,2);
T=5;
xt=A*cos(((2*pi)/T)* t+pi/4);
stem(t,xt,'b');
xlabel('x in sec');
ylabel('y(x)');
grid on;
```


5
0
-5
y(x)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
x in sec
5
0
-5
y(x)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
x in sec

Q4.

Justify whether the following signals are periodic or aperiodic with *both graphical and theatrical demonstration*.

$(a)\ x(n) = 3\cos(5n + \frac{\pi}{6})$ $(c)\ x(t) = 3\cos(5t + \frac{\pi}{6})$ $(d)\ x(t) = \sin(2\left(t - \frac{1}{2}\right))$

$(b)\ \sin 3n$

a) $x(n) = 3\cos(5n + \frac{\pi}{6})$

$x(n) = x(n+N) = 3\cos(5n + 5N + \frac{\pi}{6})$

$5N = 2\pi k$

$N = \frac{2\pi k}{5}$

Since N and k can be integer only, signal is aperiodic

b) $x(n) = \sin 3n$

$x(n) = x(n+N) = \sin(3n + 3N)$

$3N = 2\pi k$

$N = \frac{2\pi k}{3}$

Since N and k can be integer only, signal is aperiodic

c) $x(t) = 3\cos(5t + \frac{\pi}{6})$

$x(t) = x(t+T) = 3\cos(5t + 5T + \frac{\pi}{6})$

$5T = 2\pi k$

$T = \frac{2\pi k}{5}$

Keeping k = 1, $T = \frac{2\pi}{5}$

d) $x(t) = \sin(2(t - \frac{1}{2}))$

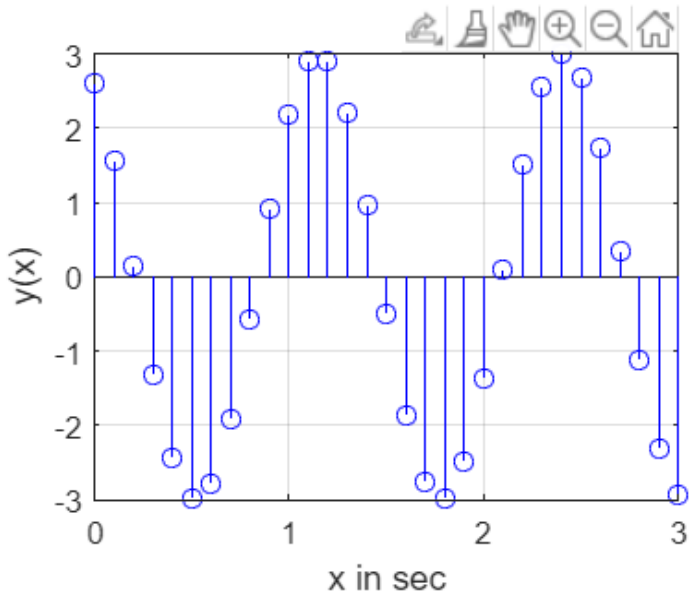
$x(t) = \sin(2t - 1)$

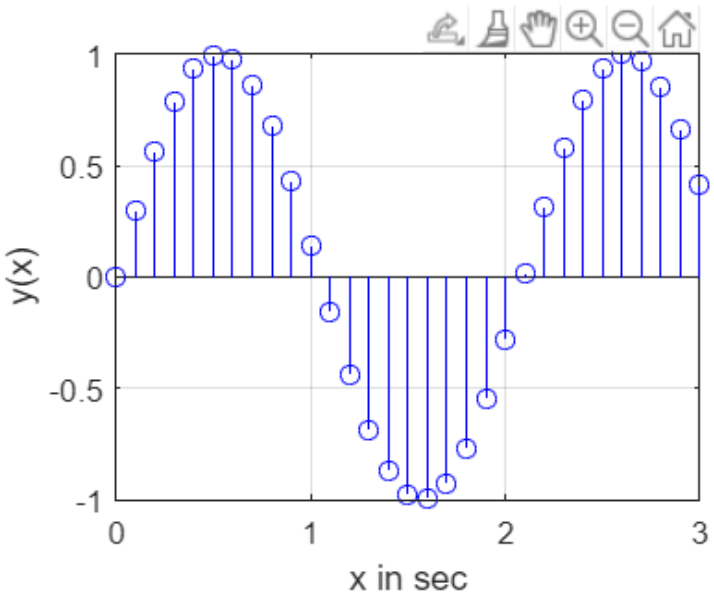
$x(t) = x(t+T) = \sin(2t + 2T - 1)$

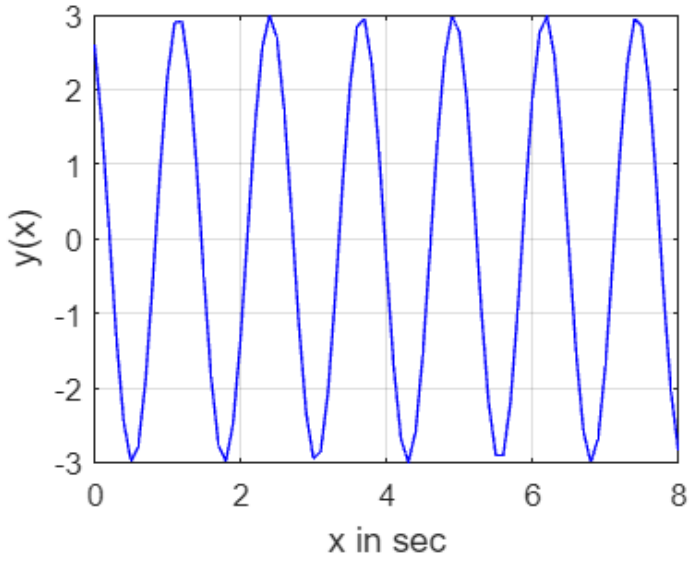
$2T = 2\pi k$

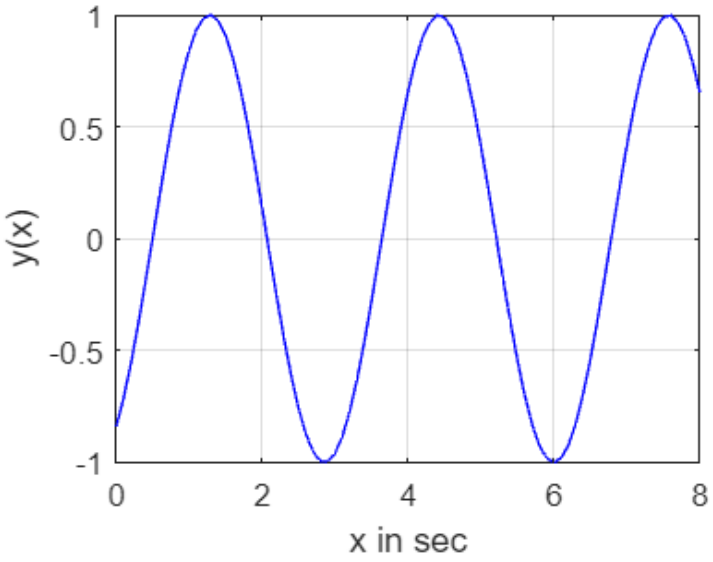
Keeping k = 1, $T = \pi$

```
n=0:0.1:3;
subplot(2,2,1);
xn=3*cos(5*n+pi/6);
stem(n,xn,'b');
xlabel('x in sec');
ylabel('y(x)');
grid on;
subplot(2,2,2);
xn=sin(3*n);
stem(n,xn,'b');
xlabel('x in sec');
ylabel('y(x)');
grid on;
t=0:0.1:8;
subplot(2,2,3);
xt=3*cos(5*t+pi/6);
plot(t,xt,'b');
xlabel('x in sec');
ylabel('y(x)');
grid on;
subplot(2,2,4);
xt=sin(2*(t-1/2));
plot(t,xt,'b');
xlabel('x in sec');
ylabel('y(x)');
grid on;
```


3
2
1
0
-1
-2
-3
y(x)
0
1
2
3
x in sec


1
0.5
0
-0.5
-1
y(x)
0
1
2
3
x in sec


3
2
1
0
-1
-2
-3
y(x)
0
2
4
6
8
x in sec


1
0.5
0
-0.5
-1
y(x)
0
2
4
6
8
x in sec

THANK YOU

YASH GUPTA

S20200010234