भारतीय सूचना प्रौद्योगिकी संस्थान, नागपुर
Indian Institute of Information Technology, Nagpur

Applied Signals & System (ECE – 205)
Lab-1 Report
Batch- ECE- IoT-1

Submitted by – Jjateen Gundesha (BT22ECI002) **Submitted to - Dr. Nikhil Agrawal**

Aim - To generate all fundamental Continuous Signals in MATLAB.

Theory – All the fundamental signals which we are going to produce are-

- **Unit impulse-** A unit impulse, often denoted as δ(t), is a mathematical function used in signal processing and mathematics. It is also known as the Dirac delta function and is defined as follows:

$$\delta (t) = 0 \text{ for } t \neq 0$$
$$\delta(t) = \infty \text{ for } t = 0$$

  The unit impulse is characterized by the property that its integral over the entire real line is equal to 1:

$$\int \delta(t)\, dt = 1$$

- **Unit step -** A unit step function, often denoted as u(t), is another mathematical function commonly used in signal processing and mathematics. It is also known as the Heaviside step function and is defined as follows:

$$u(t) = 0 \text{ for } t < 0 \quad u(t) = 1 \text{ for } t \geq 0$$

- **Unit ramp-** The unit ramp function, often denoted as r(t), is a mathematical function that represents a linear increase with time. It is sometimes referred to as the ramp function or simply the ramp. The unit ramp function is defined as follows:

$$r(t) = 0 \text{ for } t < 0$$
$$r(t) = t \text{ for } t \geq 0$$

- **Signum function (sgn (t)) -** The unit ramp function, often denoted as r(t), is a mathematical function that represents a linear increase with time. It is sometimes referred to as the ramp function or simply the ramp. The unit ramp function is defined as follows:

$$r(t) = 0 \text{ for } t < 0$$
$$r(t) = t \text{ for } t \geq 0$$

- **Single sided exponential -** A single-sided exponential function, often referred to as a one-sided exponential function, is a mathematical function that describes exponential growth or decay over a specified interval of time, typically for values greater than or equal to zero.

- **Double sided exponential -** A double-sided exponential function is a mathematical function that describes exponential growth and decay in both positive and negative directions from a reference point, often centered around $t = 0$.

- **Sin function -** The sine function, often denoted as "sin(x)," is a fundamental trigonometric function in mathematics. It describes a periodic oscillatory behavior and is used to model various wave-like phenomena, such as sound waves, electromagnetic waves, and mechanical vibrations.

- **Cos function -** The cosine function, often denoted as "cos(x)," is another fundamental trigonometric function in mathematics. Like the sine function, it describes a periodic oscillatory behavior and is used to model various wave-like phenomena, such as sound waves, electromagnetic waves, and mechanical vibrations.

- **Sinc function -** The sinc function, often denoted as "sinc(x)," is a mathematical function that arises in various areas of mathematics, physics, engineering, and signal processing. It is defined as follows:

$$\mathrm{sinc}(x) = \sin(x) / x$$

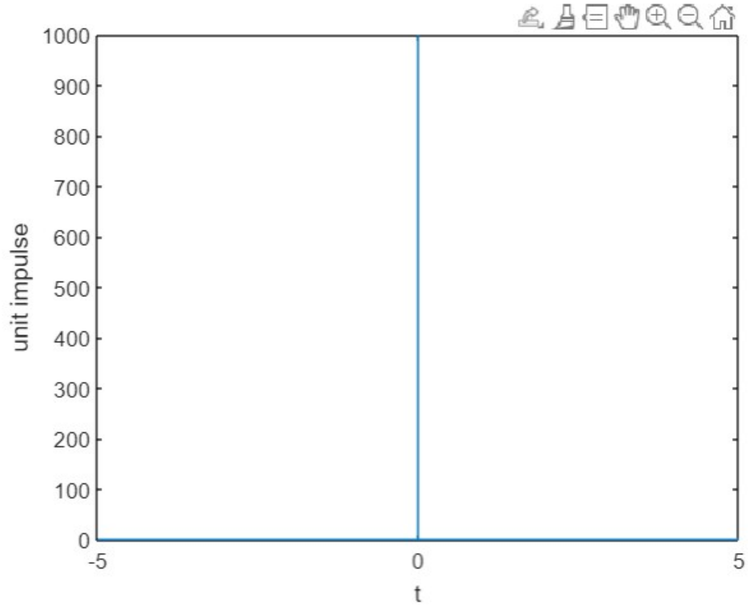
- **Gate function -** The gate function, often referred to as a rectangular pulse or rectangular function, is a mathematical function used to describe a signal or waveform that is "on" or "active" for a certain duration and "off" or "inactive" for the rest of the time.

$$g(t) = 1, \text{ for } a \leq t \leq b$$
$$g(t) = 0, \text{ otherwise}$$

<u>Code</u> :

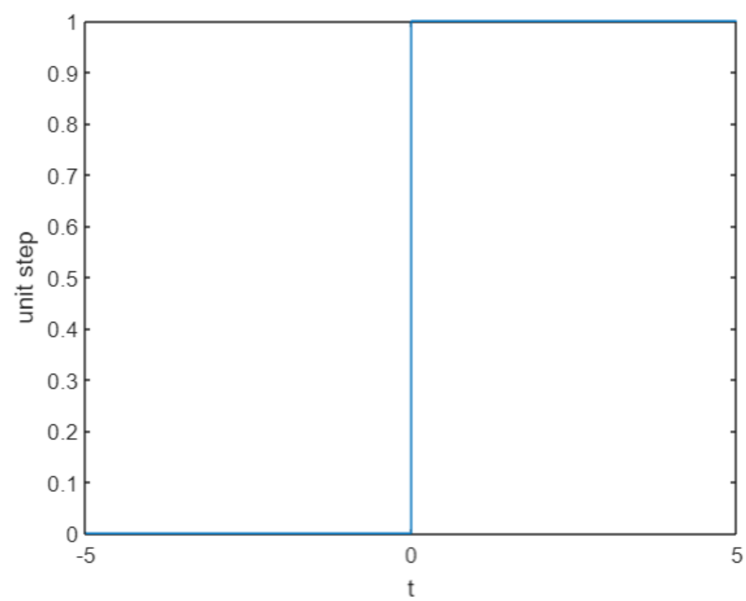
1) Unit impulse:

```
clc
clear all
close all
stepsize_t=0.001;
t = -5 : 0.001 : 5;
len_t = length(t);

for ii = 1:1:len_t
   if(t(ii)==1) %can shift impulse from this
      v_t(ii)=1/stepsize_t;
   else
      v_t(ii)=0;
   end
end
plot(t,v_t)
xlabel("t")
ylabel("unit impulse")
```



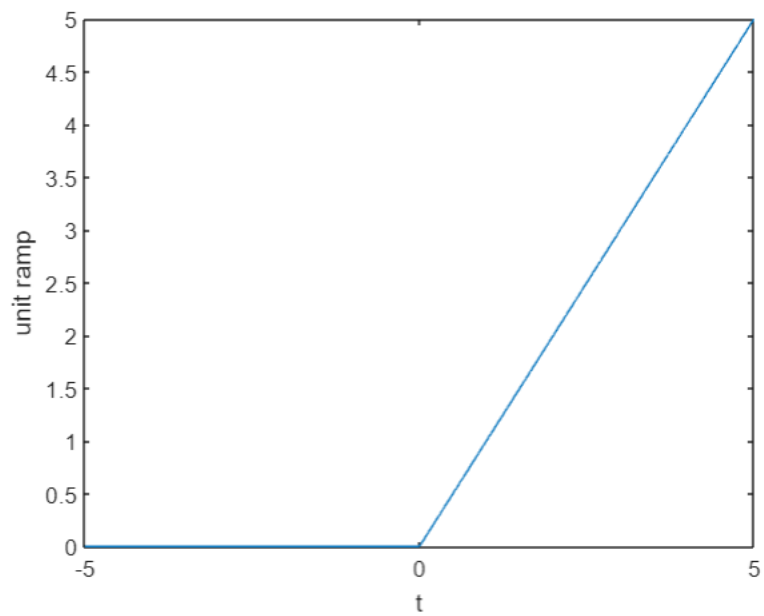
2) Unit step:

```
clc
clear all
close all
stepsize_t=0.001;
t = -5 : 0.001 : 5;
len_t = length(t);

for ii = 1:1:len_t
   if(t(ii)>=0) %can shift graph from this
      v_t(ii)=1;
   else
      v_t(ii)=0;
   end
end
plot(t,v_t)
xlabel("t")
ylabel("unit step")
```



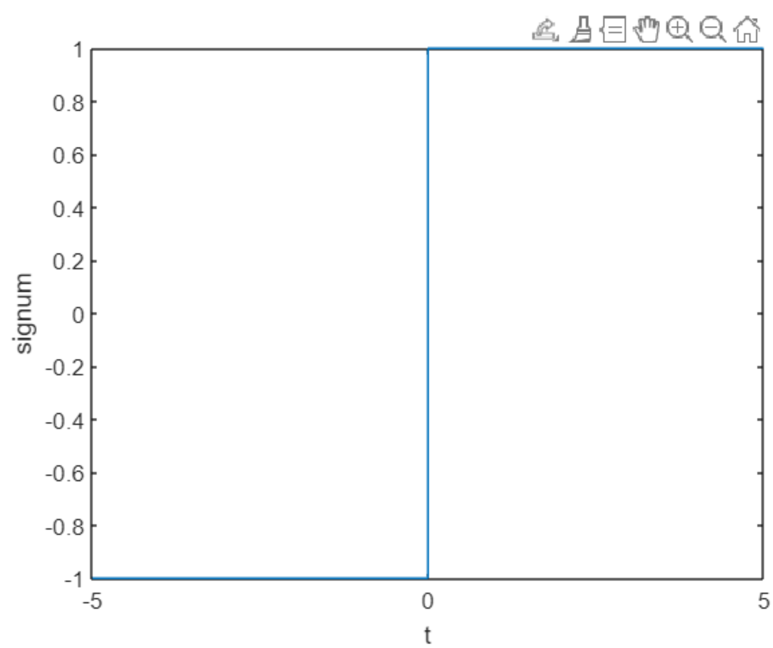
3) Unit ramp:

```
clc
clear all
close all
stepsize_t=0.001;
t = -5 : 0.001 : 5;
len_t = length(t);

for ii = 1:1:len_t
   if(t(ii)>0) %can shift graph from this
      v_t(ii)=t(ii);
   else
      v_t(ii)=0;
   end
end
plot(t,v_t)
xlabel("t")
ylabel("unit ramp ")
```



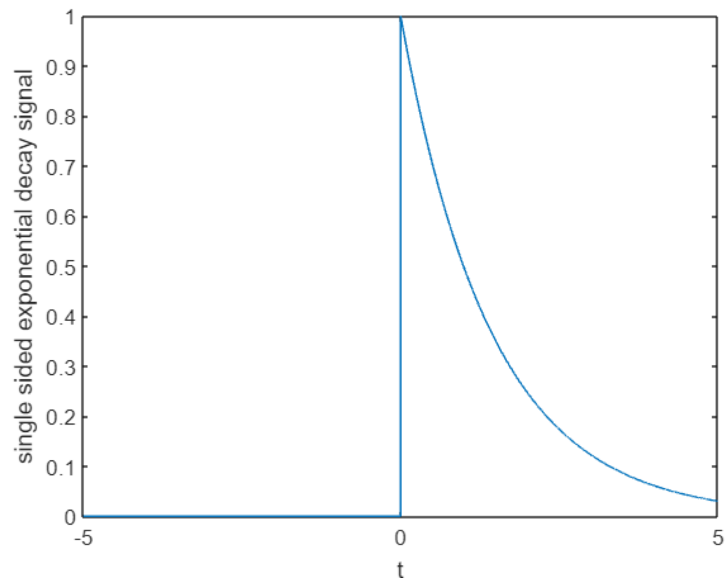
4) Signum function:

```
clc
clear all
close all
a=0.5;stepsize_t=0.001;
t = -5 : 0.001 : 5;
len_t = length(t);

for ii = 1:1:len_t
   if(t(ii)>0) %can shift graph from this
      v_t(ii)=1;
   elseif(t(ii)<0) %can shift graph from this
      v_t(ii)=-1;
   else
      v_t(ii)=0;
   end
end
plot(t,v_t)
xlabel("t")
ylabel("signum")
```



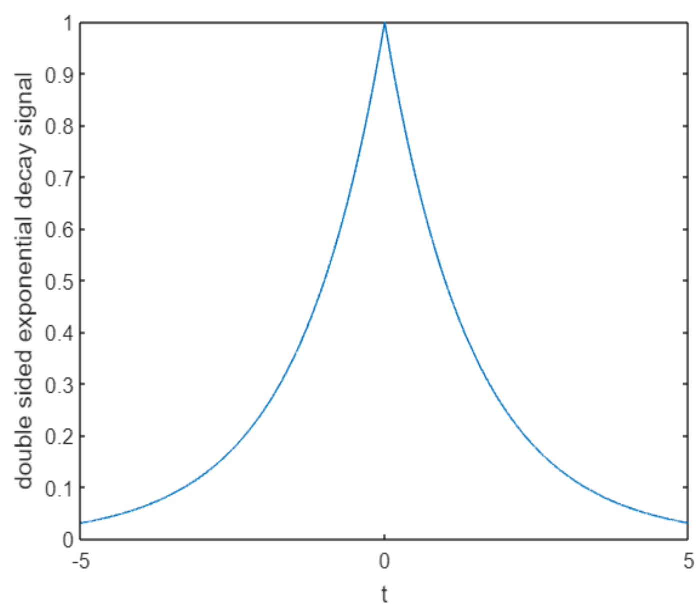
5) Single sided exponential:

```
clc
clear all
close all
a=0.5;
stepsize_t=0.001;
t = -5 : 0.001 : 5;
len_t = length(t);

for ii = 1:1:len_t
    if(t(ii)<0) %can shift graph from this
        v_t(ii)=0;
    else
        v_t(ii)=exp(-a*t(ii));
    end
end
plot(t,v_t)
xlabel("t")
ylabel("single sided exponential decay signal")
```



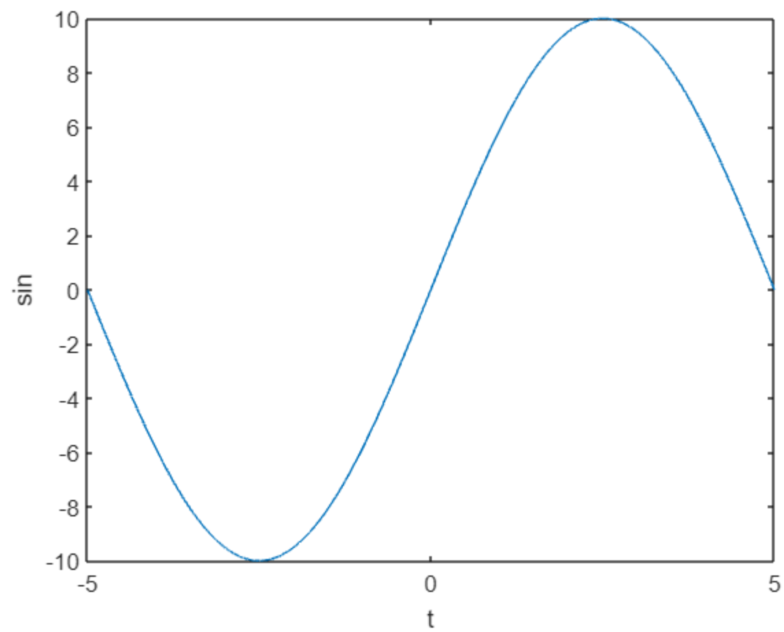
6) Double sided exponential:

```
clc
clear all
close all
a=0.5;
stepsize_t=0.001;
t = -5 : 0.001 : 5;
len_t = length(t);

for ii = 1:1:len_t
     v_t(ii)=exp(-a*abs(t(ii)));

end
plot(t,v_t)
xlabel("t")
ylabel("double sided exponential decay signal")
```



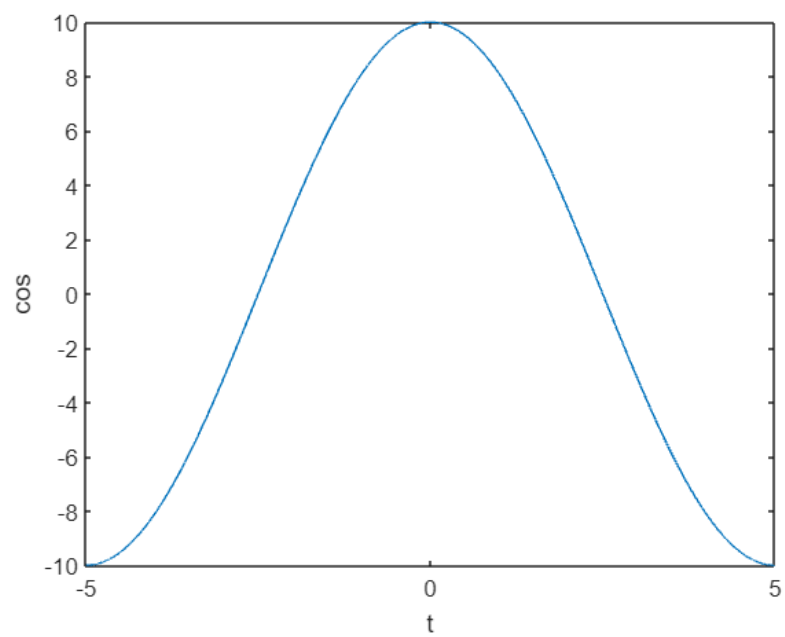
7) Sin function:

```
clc
clear all
close all
a=0.5;
stepsize_t=0.001;
t = -5 : 0.001 : 5;
len_t = length(t);

for ii = 1:1:len_t
    v_t(ii)=sin(t(ii));

end
plot(t,v_t)
xlabel("t")
ylabel("sin")
```



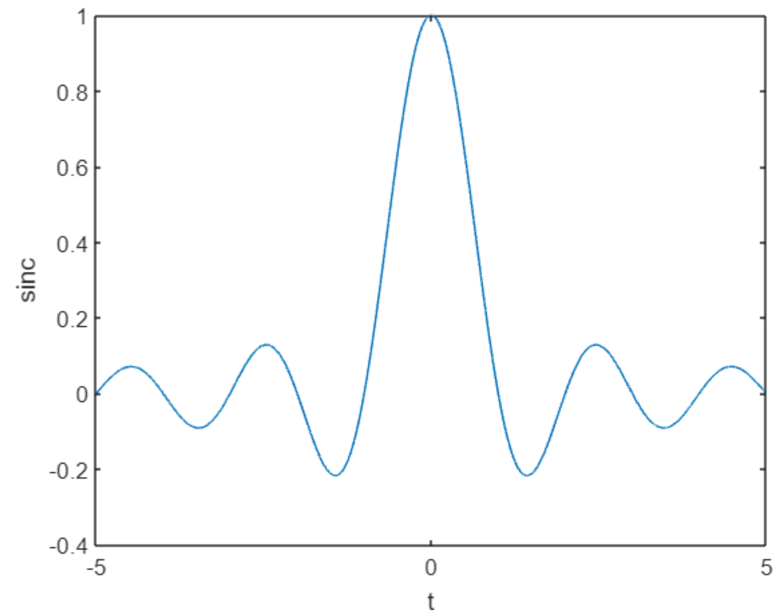
8) Cos function:

```
clc
clear all
close all
a=0.5;
stepsize_t=0.001;
t = -5 : 0.001 : 5 ;
len_t = length(t);

for ii = 1:1:len_t
    v_t(ii)=cos(t(ii));

end
plot(t,v_t)
xlabel("t")
ylabel("cos")
```



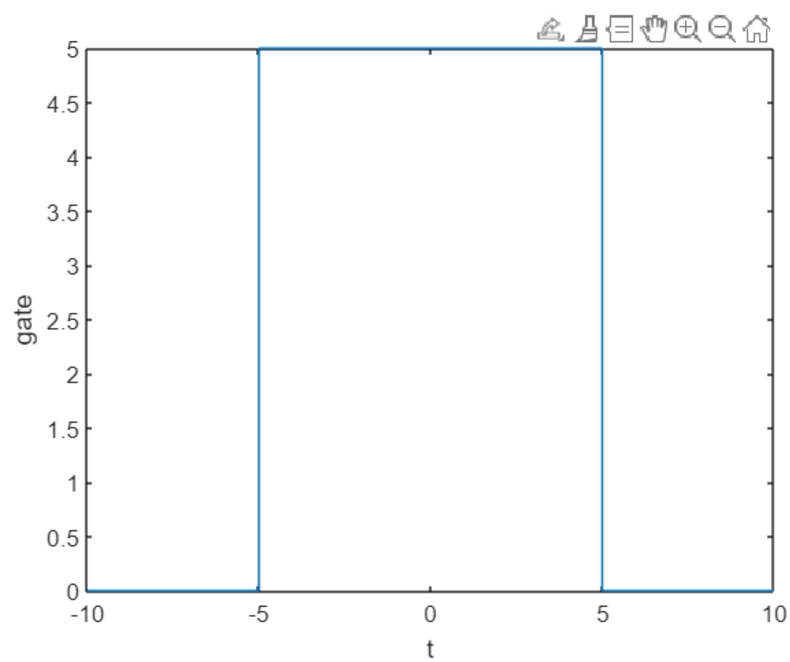
9) Sinc function:

```
clc
clear all
close all
a=0.5;
stepsize_t=0.001;
t = -5 : 0.001 : 5;
len_t = length(t);

for ii = 1:1:len_t
    v_t(ii)=sin(2*pi*t(ii))/(2*pi*t(ii));

end
plot(t,v_t)
xlabel("t")
ylabel("sinc")
```



10) Gate function:

```
clc
clear all
close all
a=0.5;
stepsize_t=0.001;
t = -10 : 0.001 : 10;
len_t = length(t);

for ii = 1:1:len_t
   if(t(ii)>-5 && t(ii)<5)
      v_t(ii)=5;
   else
      v_t(ii)=0;
   end
end
plot(t,v_t)
xlabel("t")
ylabel("gate ")
```



Conclusion: By generating and working with these fundamental continuous signals in MATLAB, we gained a deeper understanding of their characteristics, behavior, and mathematical representations. These signals play a pivotal role in numerous engineering and scientific applications, serving as the basis for more complex signal manipulation, analysis, and processing.