# Tribhuvan University

Institute of Engineering

# Pulchowk Campus


Digital Signal Analysis and Processing

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# Lab 2

## Basic CT/DT functions

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Submitted on:

14th August, 2022

**Title**
Basic CT/DT functions

## Background Theory

### Continuous Time Signal

A continuous time signal is a function that is continuous, meaning there are no breaks in the signal. For all real values of t, f(t) exists. CT signals are ususally represented by using x(t), having a parentheses and the variable t.

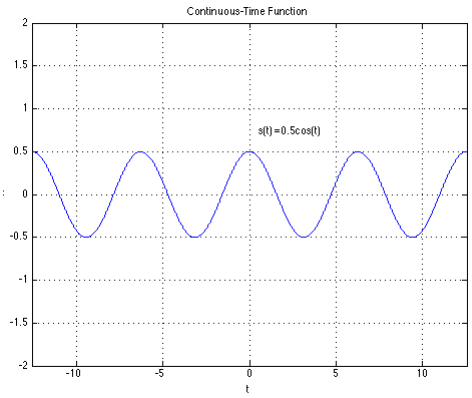


Figure 1: CT Signals

### Discrete Time Signals

A discrete time signal is a signal whose value is taken at discrete measurements. For discrete time signal, the function exists only at a certain interval of timr. Thus there will be time periods of n where F(n) doesn't have a value. DT signals are represented using the form x[n]. Discrete signals are the approximations of CT signals

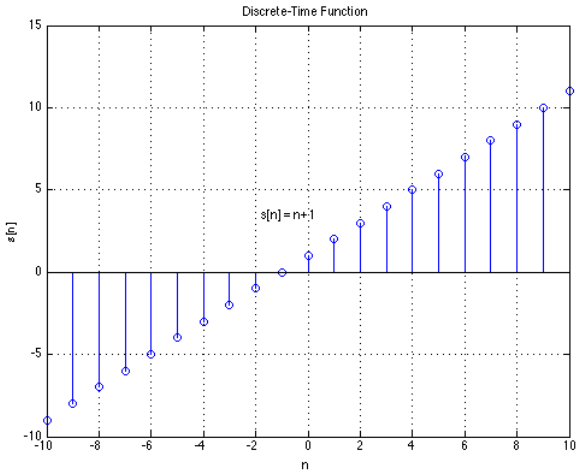


Figure 2: DT Signals

### Some basic CT/DT functions

- Sinusoidal function
  Trig functions like sine and cosine have periodic graphs which we called Sinusoidal Graph, or Sine wave. They're three features of sinusoidal graphs.

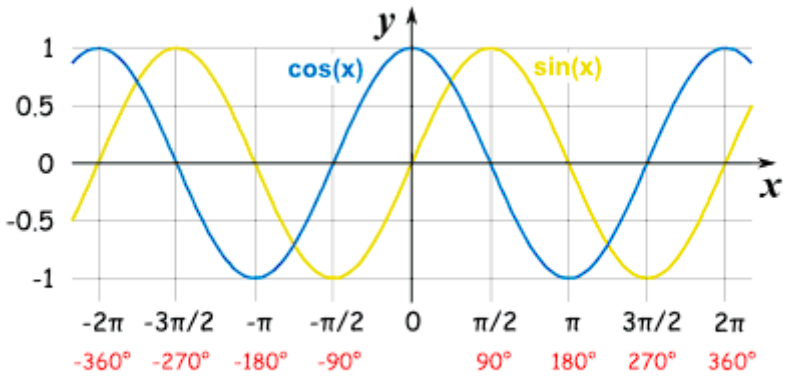


Figure 3: Sine and cosine wave

- **Midline**: is the horizontal line that passes exactly in the middle between the graph's maximum and minimum points.
- **Amplitude**: is the vertical distance between the midline and one of the extremum points.
- **Period**: Also called frequency, is the distance between two consecutive maximum points, or two consecutive minimum points (these distances must be equal).

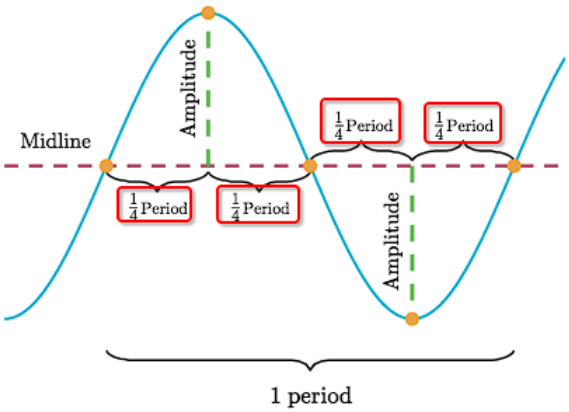


Figure 4: Sinusoidal wave features

In MATLAB. sinusoidal functions can simply be called as

```
sin(x)
cos(x)
```

- Ramp function
  The ramp function is a unary real function, whose graph is shaped like a ramp. In this lab, ramp function denotes the unit ramp function (slope 1, starting at 0).

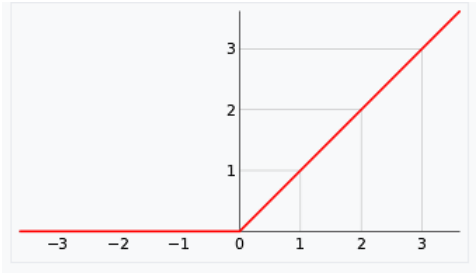


Figure 5: Ramp wave

In MATLAB. ramp functions can simply be called as

```
ramp(x)
```

- Exponential function
  An exponential function is simply a function in which the independent variable is the exponent. Exponential function is defined as:

```
If b is any number such that b > 0 and b != 1 then,
an exponential function is a function in the form,
f(x) =b^x
where
b is called the base and
x can be any real number.
```

Exponential functions can be increasing or decreasing.

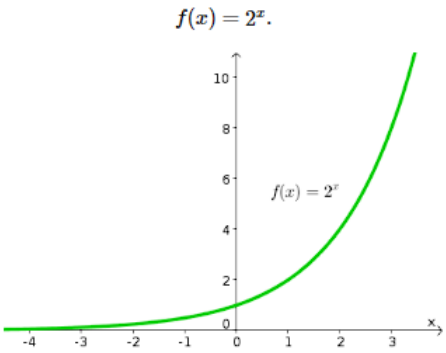


Figure 6: Increasing exponential function

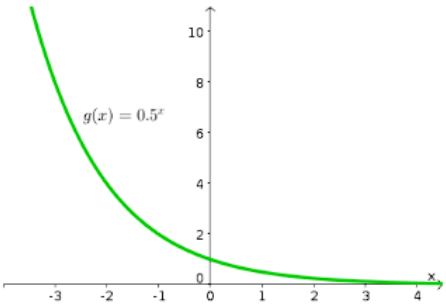


Figure 7: Decreasing exponential function

In MATLAB. exponential functions can simply be called as

```
exp(x)
```

- Unit step function
  The unit step function is a function whose is zero for negative arguments and one for positive arguments.

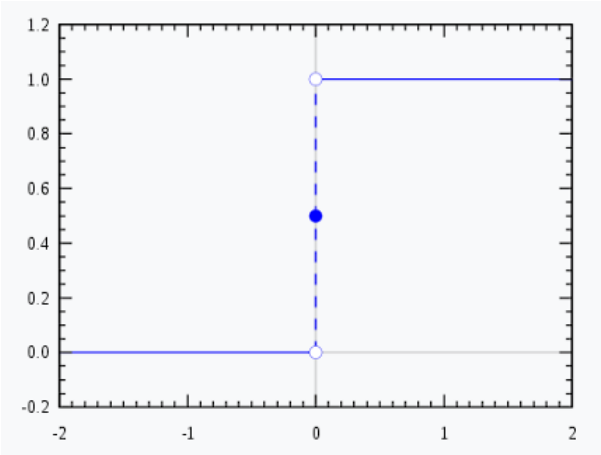


Figure 8: Unit Step function

In MATLAB. unit step functions can simply be called as

```
heaviside(x)
```

- Unit impulse functions
  The unit impulse function is a function whose is one for 0 as argument and zero for all other arguments.

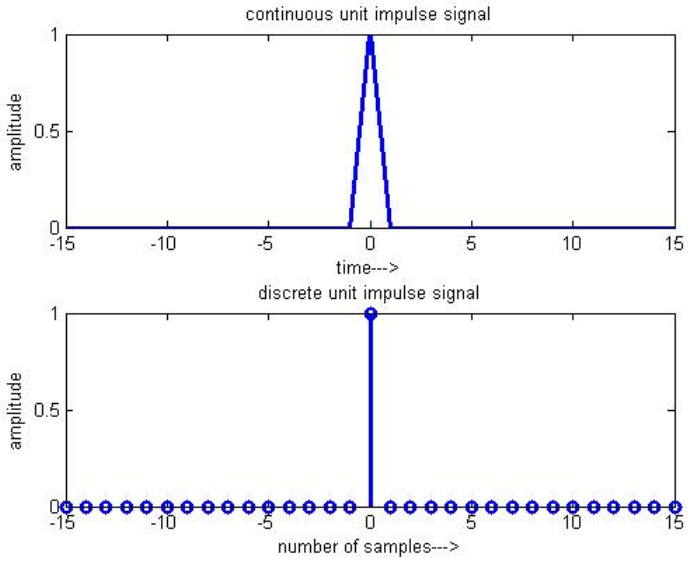


Figure 9: Unit Impulse function

In MATLAB. unit impulse functions can simply be called as

```
dirac(x)
```

**Activity**

1. Sinusoidal signals

- Continuous Sine wave

```
t = -10:0.01:10
x = sin(t)
plot(t,x)
xlabel('t')
ylabel('x')
title(sinosoidal)
```

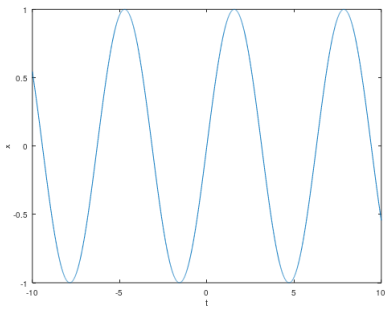

Figure 10: Continuous sine wave

- Discrete Sine wave

```
t = -10:0.5:10
x = sin(t)
stem(t,x)
xlabel('t')
ylabel('x')
title(sinosoidal)
```

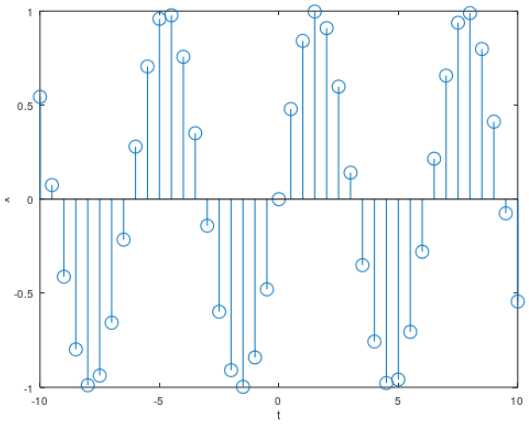

Figure 11: Discrete sine wave

- Sine wave with hold on

```
t = -10:0.01:10
x = sin(t)
y=cos(t)
plot(t,x)
hold on
plot(t,y)
hold off
```

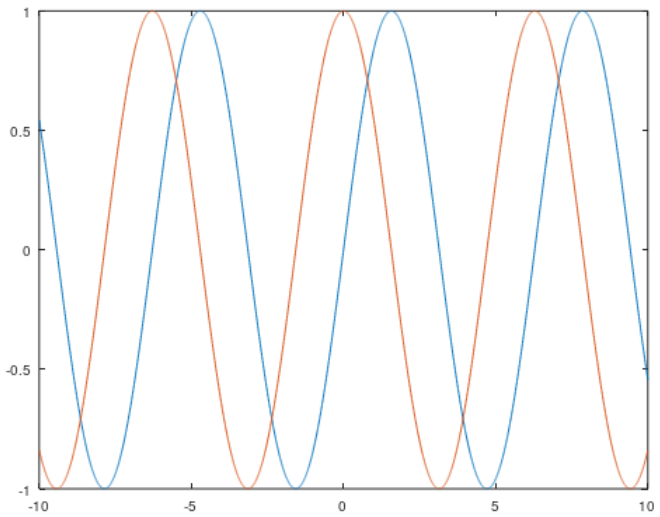


Figure 12: sine wave and cosine wave

2. Ramp signals

```
x= -10:10
y=x
plot(x,y)
```

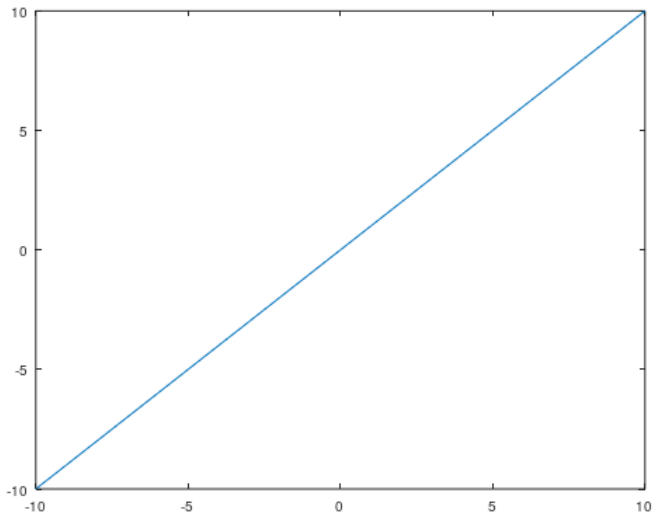


Figure 13: Ramp wave

3. Exponential signals

- Exponentially growing

```
n= -10:10
a = 0.25
c=2
y = c*exp(a*n)
stem(n,y)
title('Éxponentiallly growing']
```

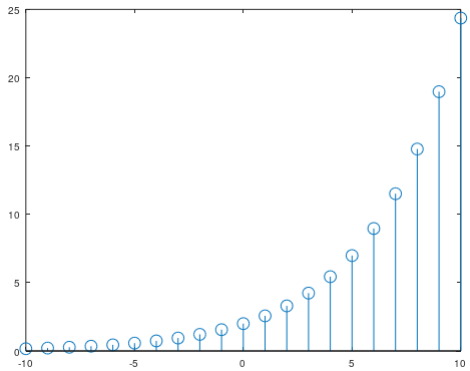


Figure 14: Éxponentiallly growing wave

- Exponentially decaying wave

```
n= -10:10
a = -0.25
c=2
y = c*exp(a*n)
stem(n,y)
```

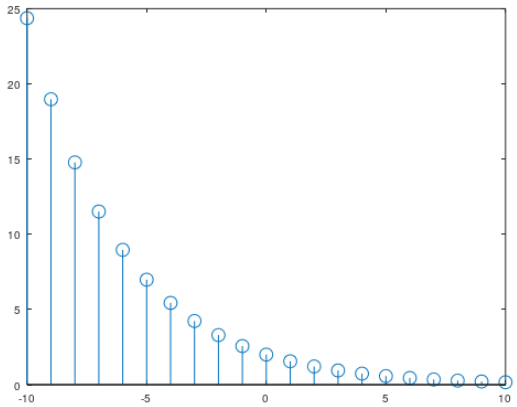


Figure 15: Exponentially decaying wave

- Constant Wave

```
n= -10:10
a = 0
c=2
y = c*exp(a*n)
stem(n,y)
```

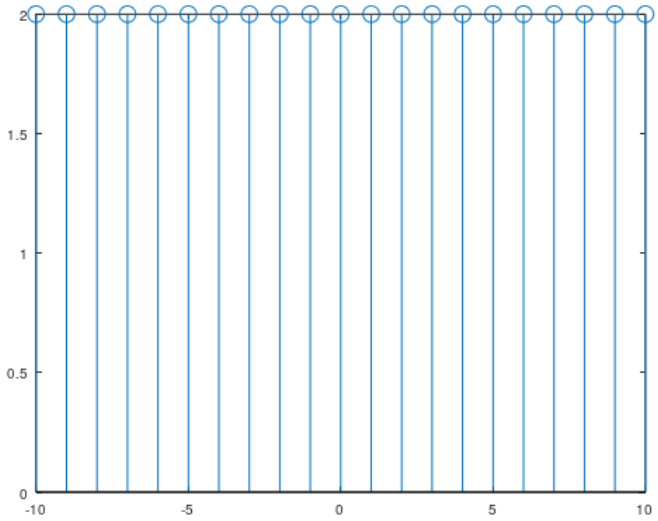


Figure 16: Constant wave

4. Unit step signals

```
hold on
for(n =-10:10)
    if(n<0)
        stem(n,0)
    else
        stem(n,1)
    end
end
hold off
```

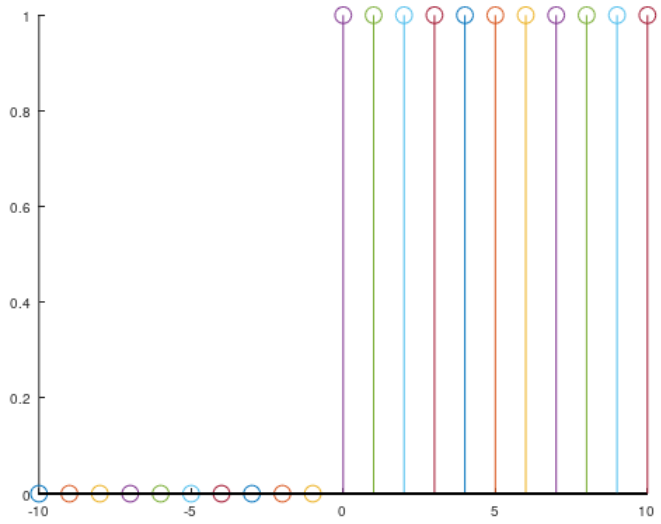


Figure 17: Unit step function

5. Unit impulse signals

```
hold on
for(n =-10:10)
    if(n==0)
        stem(n,1)
    else
        stem(n,0)
    end
end
hold off
```

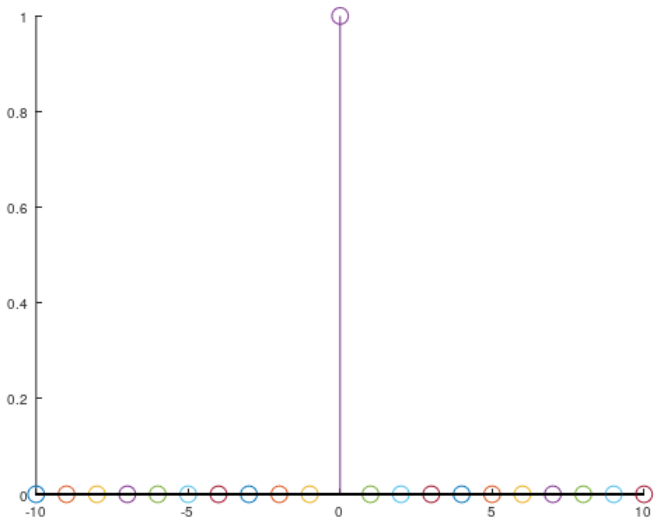


Figure 18: Unit impulse function

**Conclusion**

In this way "Lab 2: Basic CT/DT functions" was completed via the use of MATLAB. Five basic functions were studied.The functions were:

- Sinusoidal function
- Ramp function
- Exponential function
- Unit step function
- Unit impulse function