DSP LABWORK

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Week 1: **Generation of Given Sequences using MATLAB**

Aim:

To generate any given Discrete Time Signal and plot them in MATLAB

Software Used:

MATLAB R2020

Pseudo Code:

1. Recall the definition of standard signals
2. Implement the equations of standard signals in MATLAB
3. Modify and perform operations on standard signals to arrive at any given Discrete Time Signal

Signals to be generated:

```
1. (a)Unit Impulse del[n]- n varies from 0 to 10 where n values not specified
    (b)Unit Step      u[n] -                 ''
    (c)Unit ramp     r[n]-                  ''
    (d)y[n] = 2del[n-1] -4del[n+2] ; -5 <= n <= 5
    (e)x[n] = cos[0.04*pi*n]
    (f)x[n] = n[u[n] - u[n-10]] + 10e-0.3(n-10)[u[n] - u[n-10]]; 0<=n<=20


2. If x[n] = {1 2 3 4 5 6 7 6 5 4 3 2 1}
    a. X1[n] = 2x[n-5] - 3x[n+4]
    b. x2[n] = x[3-n] - x[n]x[n-2]


3. If x[n] = = e(0.1+j0.3)n ; -10 <= n <= 10, plot its magnitude, phase, real
part and imaginary part
```

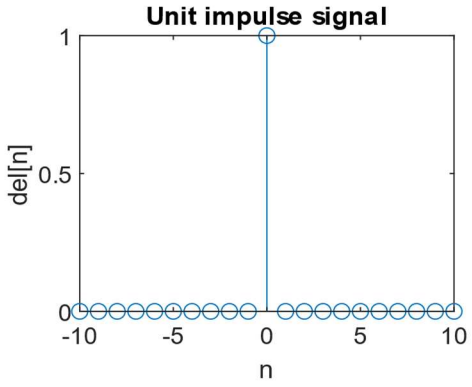
Question 1:

(a) Code:

```
%Impulse signal
%Signal Generation

clc
clear all
n = [-10:10];
for i=1:length(n)
    if(n(i)==0)
        xn(i) = 1;
    else
        xn(i) = 0;
    end
end

%This is for plotting
subplot(2,2,1); stem(n,xn);
xlabel("n");
```

```
ylabel("del[n]");
title("Unit impulse signal");
```

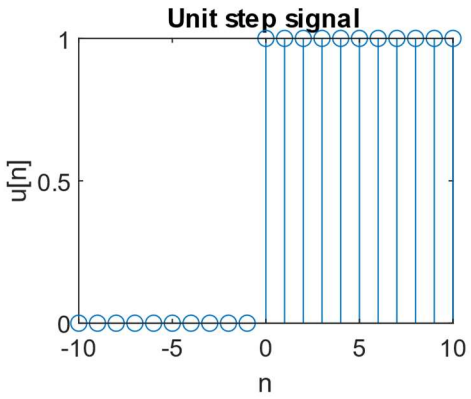
Waveform:



(b) Code:

```
%Unit step signal
%Signal Generation
clc
clear all
n = [-10:10];
for i=1:length(n)
    if(n(i) >= 0)
        xn(i)=1;
    else
        xn(i)=0;
    end
end

%This is for plotting
stem(n,xn);
xlabel("n");
ylabel("u[n]");
title("Unit step signal");
```

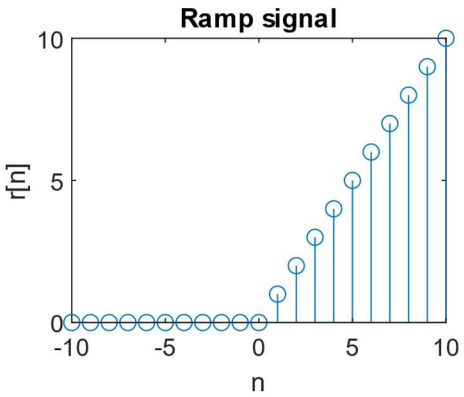
Waveform:



(c) Code:

```
%Ramp signal
%Signal Generation
clc
clear all
n = [-10:10];
for i = 1:length(n)
    if(n(i)>=0)
        xn(i)=n(i);
    else
        xn(i) = 0;
    end
end

%This is for plotting
stem(n,xn);
xlabel("n");
ylabel("r[n]");
title("Ramp signal")
```

Waveform:

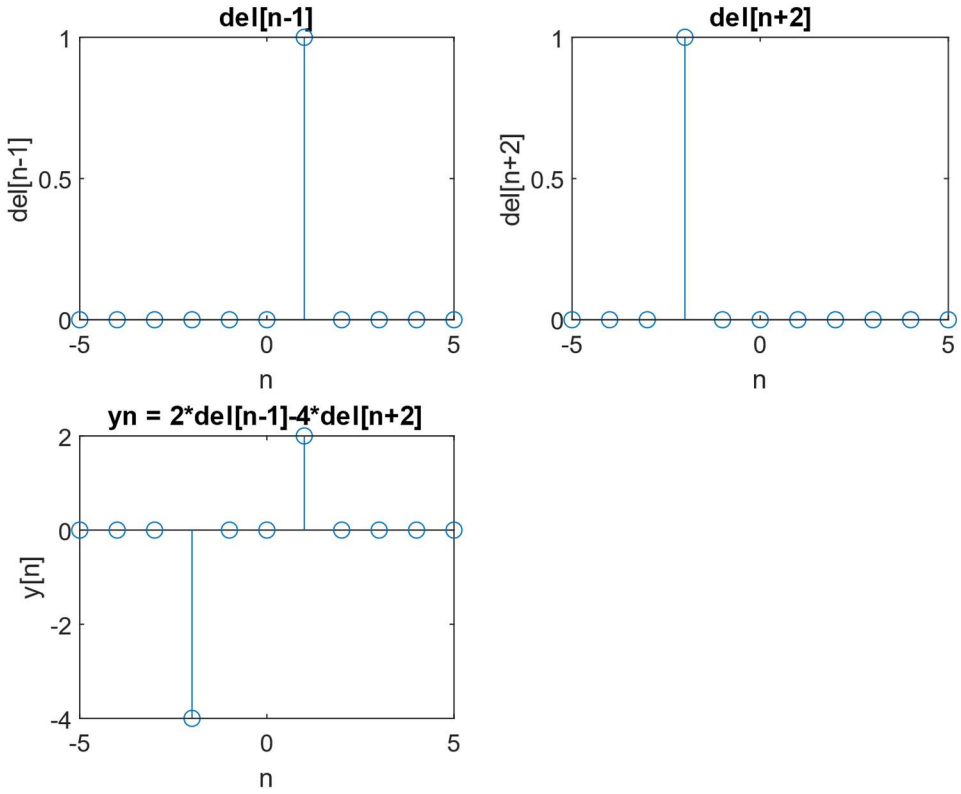


(d) Code:

```
%y[n]=2*del[n-1]-4*del[n+2]; -5<= n <= 5

clc
clear all
n = [-5:5];


for i=1:length(n)
    if(n(i)==1)
        delnm1(i) = 1;
    else
        delnm1(i) = 0;
    end
end


for i=1:length(n)
    if(n(i)==-2)
        delnp2(i) = 1;
    else
        delnp2(i) = 0;
    end
end

yn = 2*delnm1 - 4*delnp2;

subplot(2,2,1); stem(n,delnm1);
xlabel("n");ylabel("del[n-1]");title("del[n-1]");

subplot(2,2,2); stem(n,delnp2);
title("del[n+2]");xlabel("n");ylabel("del[n+2]");
```

```
subplot(2,2,3); stem(n,yn);
title("yn = 2*del[n-1]-4*del[n+2]");xlabel("n");ylabel("y[n]");
```

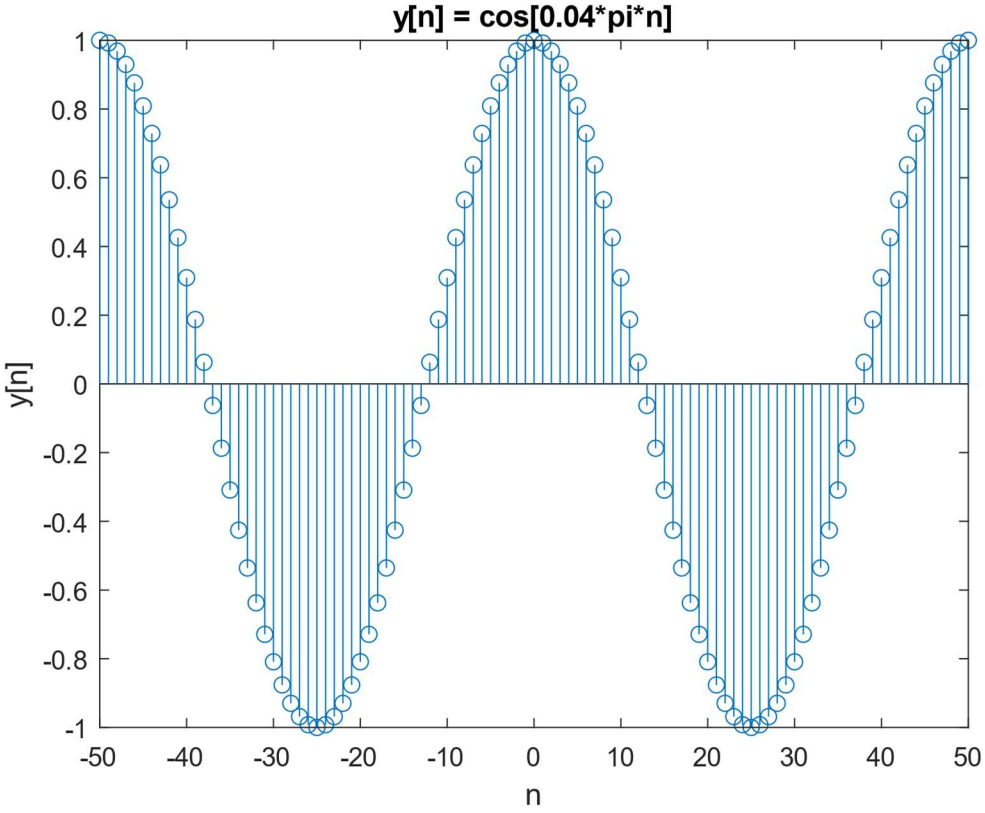
Waveform:



(e) Code:

```
%y[n] = cos[0.04*pi*n] ; -5 <= n <= 5

clc
clear all
n = [-50:50];
%yn=zeros(length(n));
for i = 1:length(n)
    yn(i) = cos(0.04*pi*n(i));
end

stem(n,yn);title("y[n] = cos[0.04*pi*n]");xlabel("n");ylabel("y[n]");
```

Waveform:

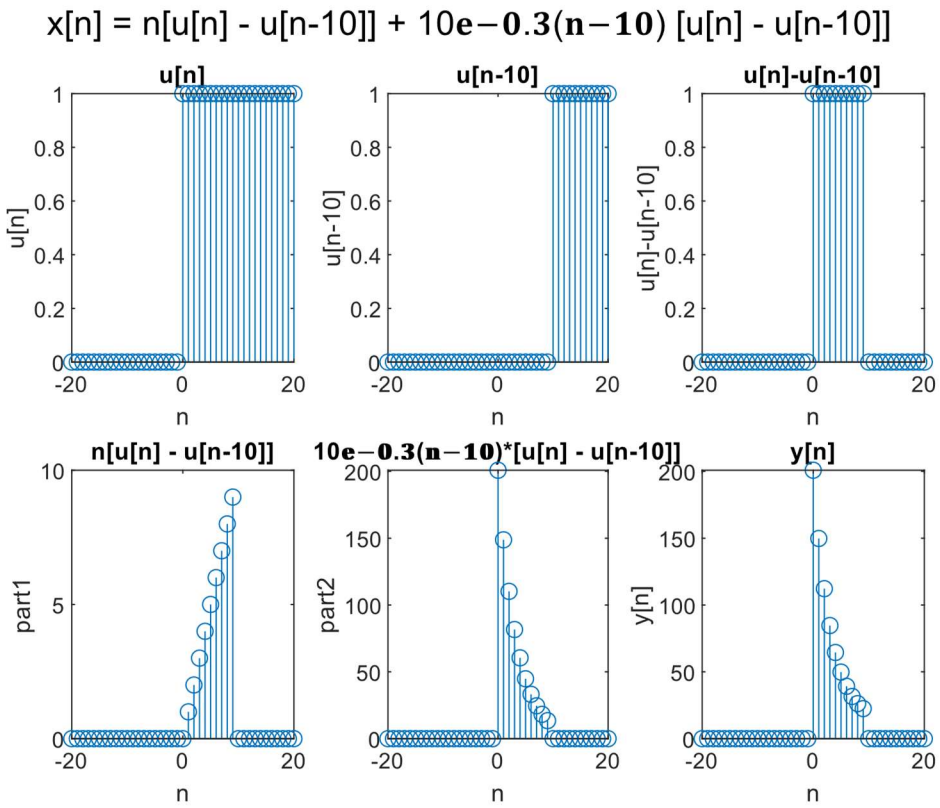


(f) Code:

```
%x[n] = n[u[n] - u[n-10]] + 10e-0.3(n-10)[u[n] - u[n-10]]; 0<=n<=20

clc
clear all
n = [-20:20];

for i=1:length(n)
    if(n(i) >= 0)
        un(i)=1;
    else
        un(i)=0;
    end
end

for i=1:length(n)
    if(n(i) >= 10)
        unm10(i)=1;
    else
        unm10(i)=0;
    end
end

for i=1:length(n)
    part1(i) = n(i)*(un(i) - unm10(i))
end

for i=1:length(n)
    part2(i) = 10*exp(-0.3*(n(i)-10))*(un(i)-unm10(i));
end

yn = part1 + part2;
```

```
sgtitle("x[n] = n[u[n] - u[n-10]] + 10???.?(????) [u[n] - u[n-10]]")

subplot(2,3,1); stem(n,un);
xlabel("n");ylabel("u[n]");title("u[n]");

subplot(2,3,2); stem(n,unm10);
xlabel("n");ylabel("u[n-10]");title("u[n-10]");

subplot(2,3,3); stem(n,un-unm10);
xlabel("n");ylabel("u[n]-u[n-10]");title("u[n]-u[n-10]");

subplot(2,3,4); stem(n,part1);
xlabel("n");ylabel("part1");title("n[u[n] - u[n-10]]");

subplot(2,3,5); stem(n,part2);
xlabel("n");ylabel("part2");title("10???.?(????)*[u[n] - u[n-10]]");

subplot(2,3,6); stem(n,yn);
xlabel("n");ylabel("y[n]");title("y[n]");
```

Waveform:



Question 2:

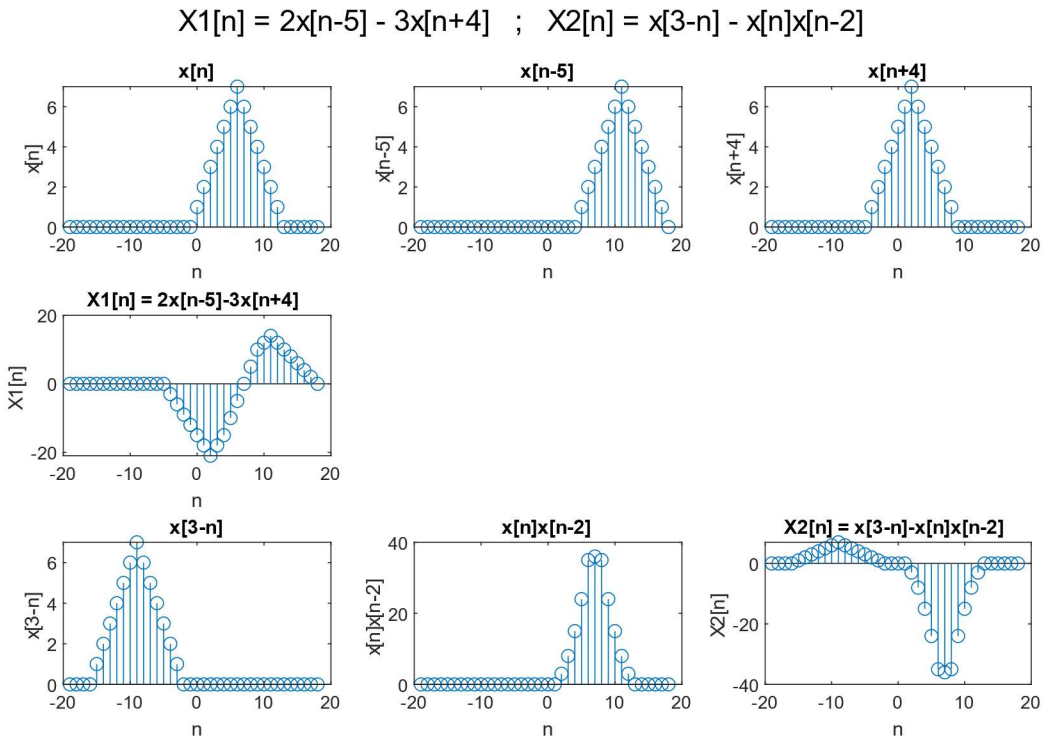
(a) and (b) Code:

```
%2. If x[n] = {1 2 3 4 5 6 7 6 5 4 3 2 1}

%a. X1[n] = 2x[n-5] - 3x[n+4]
%b. x2[n] = x[3-n] - x[n]x[n-2]
clc
clear variables
xn = [1, 2, 3, 4 ,5, 6, 7, 6, 5, 4, 3, 2, 1];

xnSize = length(xn);
xntemp(1:6) = 0;                        %Change 10 to any other number
```

```
                                        %if full signal is not visibles
sizeOfHalf = length(xn) + length(xntemp);
xn = [xntemp, xn*0, xn, xntemp];        %Since we are shifting,
                                        %let's add few extra 0s to x[n]
                                        %Creating symmetrical sampling
                                        %points
n = [-(length(xntemp)+xnSize) : (length(xntemp)+xnSize-1)];



%x[n-5]
for i=1:length(n)
    if(i <= 5)
        xnm5(i) = 0;
    else
        xnm5(i) = xn(i-5);
    end
end

%x[n+4]
for i= 1:length(n)
    if(i >= length(xn)-4 )
        xnp4(i) = 0;
    else
        xnp4(i) = xn(i+4);
    end
end

%a. X1[n] = 2x[n-5] - 3x[n+4]
sgtitle("X1[n] = 2x[n-5] - 3x[n+4]   ;   X2[n] = x[3-n] - x[n]x[n-2]");
X1n = 2*xnm5 - 3*xnp4

subplot(3,3,1); stem(n,xn);
xlabel("n");ylabel("x[n]");title("x[n]");

subplot(3,3,2); stem(n,xnm5);
xlabel("n");ylabel("x[n-5]");title("x[n-5]");

subplot(3,3,3); stem(n,xnp4);
xlabel("n");ylabel("x[n+4]");title("x[n+4]");

subplot(3,3,4); stem(n,X1n);
xlabel("n");ylabel("X1[n]");title("X1[n] = 2x[n-5]-3x[n+4]");



%x[n-2]
for i=1:length(n)
    if(i <= 2)
        xnm2(i) = 0;
    else
        xnm2(i) = xn(i-2);
    end
end

%x[-n]
%The index n=0 is length(xntemp)+xnSize+1
indexOfZero = sizeOfHalf+1;
xrev = xn;
for i=1:xnSize
    temp = xrev(indexOfZero+i);
    xrev(indexOfZero+i) = xrev(indexOfZero-i);
    xrev(indexOfZero-i)=temp;
end
```

```
%x[3-n] = x[-n+3]
for i=1:length(xrev)
    if(i>=length(xrev)-3)
        x3mn(i)=0;
    else
        x3mn(i)=xrev(i+3);
    end
end
%b. x2[n] = x[3-n] - x[n]x[n-2]
X2n = x3mn - xn.*xnm2;

subplot(3,3,7); stem(n,x3mn);
xlabel("n");ylabel("x[3-n]");title("x[3-n]");

subplot(3,3,8); stem(n,xn.*xnm2);
xlabel("n");ylabel("x[n]x[n-2]");title("x[n]x[n-2]");

subplot(3,3,9); stem(n,X2n);
xlabel("n");ylabel("X2[n]");title("X2[n] = x[3-n]-x[n]x[n-2]");
```

Waveform:



Question 3:

(a) Code:

```
%x[n] = = e(?0.1+j0.3)n ; -10 ? n ? 10,


n=[-10:10];
xn = exp((-0.1+0.3j)*n);

sgtitle("x[n] = = e(?0.1+j0.3)n");
subplot(2,2,1);stem(n,real(xn));
xlabel("n");ylabel("Re(x[n])");title("Re{x[n]}");

subplot(2,2,2);stem(n,imag(xn));
```

```
xlabel("n");ylabel("Im(x[n])");title("Im{x[n]}");

subplot(2,2,3);stem(n,abs(xn));
xlabel("n");ylabel("|x[n]|");title("|x[n]|");

subplot(2,2,4);stem(n,angle(xn));
xlabel("n");ylabel("<(x[n]");title("<(x[n])");
```

Waveform: