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Section 1

EEE321 Lab Work 1

Introduction

In this lab work we are going go work on digital signals, which are discrete and quantized. It is expected to work on discrete cosine signals. The property of discrete cosine signals are that they are only defined over integers. This property is not peculiar to discrete cosine signals, all the discrete signals are defined over integer variables. The general formula of discrete cosine signal is given below.

$$x[n] = A * \cos[\omega n + \phi]\,, n \in Z$$

In the formula above A represents the maximum amplitude of the signal, ω represents normalized frequency (in radians) and ϕ represents the phase shift (in radians) of the function.

In the lab manual there are 12 different discrete cosine signal and few questions that some of these questions are about the given cosine signals and the others are general questions. In this lab report all the thing indicated in the lab manual will be shown and the codes will be attached to appendix part.

Questions & Results

1-)

$$x_1[n] = \cos[0.14\pi n]$$

1-a)

The wanted files are created and the retrieved from directory for all 12 questions, the related codes are shown in appendix part.

Quantization means that the transformation of a continuous signal to a finite interval of discrete values. This process happens when we try to transfer the mathematical continuous functions to digital environment. Normally, there are infinitely many values of the signal that corresponds to wanted interval; however, computers cannot store infinite amount of data since there is no infinite space. To handle this problem, the data is divided equally to wanted number of points, and some approximations are done when there are irrational numbers that corresponds to wanted variables.

When x_1 is stored by computer, it had to be quantized. It is because x_1 is a continuous function in normal circumstances and some of their values are irrational. To store it in a small space it has been quantized.

Read and printed Results are:

```
x_1[2] : 0.905
x_1[8] : -0.998
x_1[111] : -0.309
x_1[127] : 0.426
```

1-b)

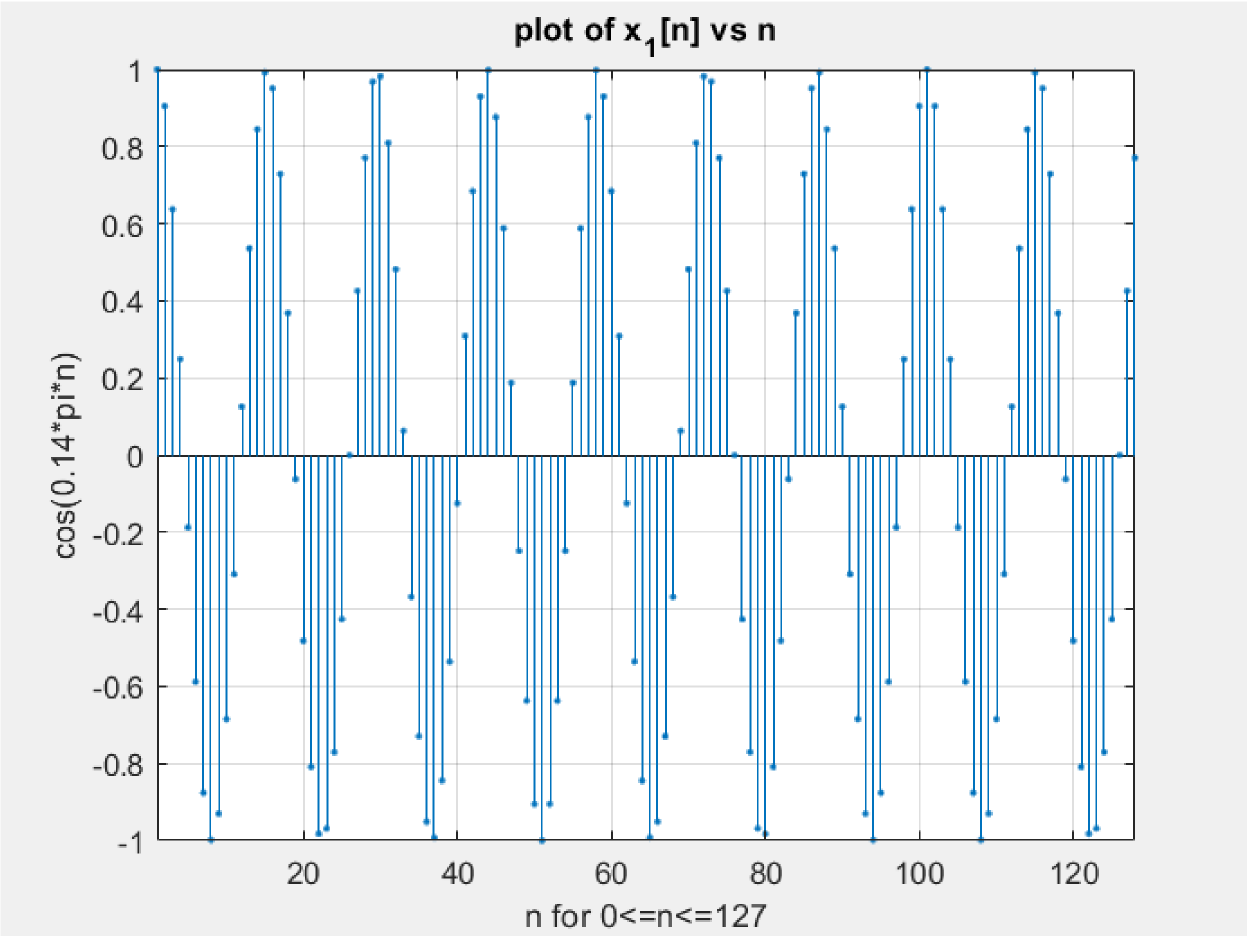

Figure-1) Plot of x_1[n] vs n

The value of ω is 0.14π rad.

2-)

$$x_2\,[n] = \cos[2.3\pi n]$$

2-a)

When x_2 is stored by computer, it had to be quantized. It is because x_2 is a continuous function in normal circumstances and some of their values are irrational. To store it in a small space it has been quantized.

Read and printed Results are:

```
x_2[2] : 0.588
x_2[8] : 0.951
x_2[111] : -1.000
x_2[127] : 0.809
```

2-b)

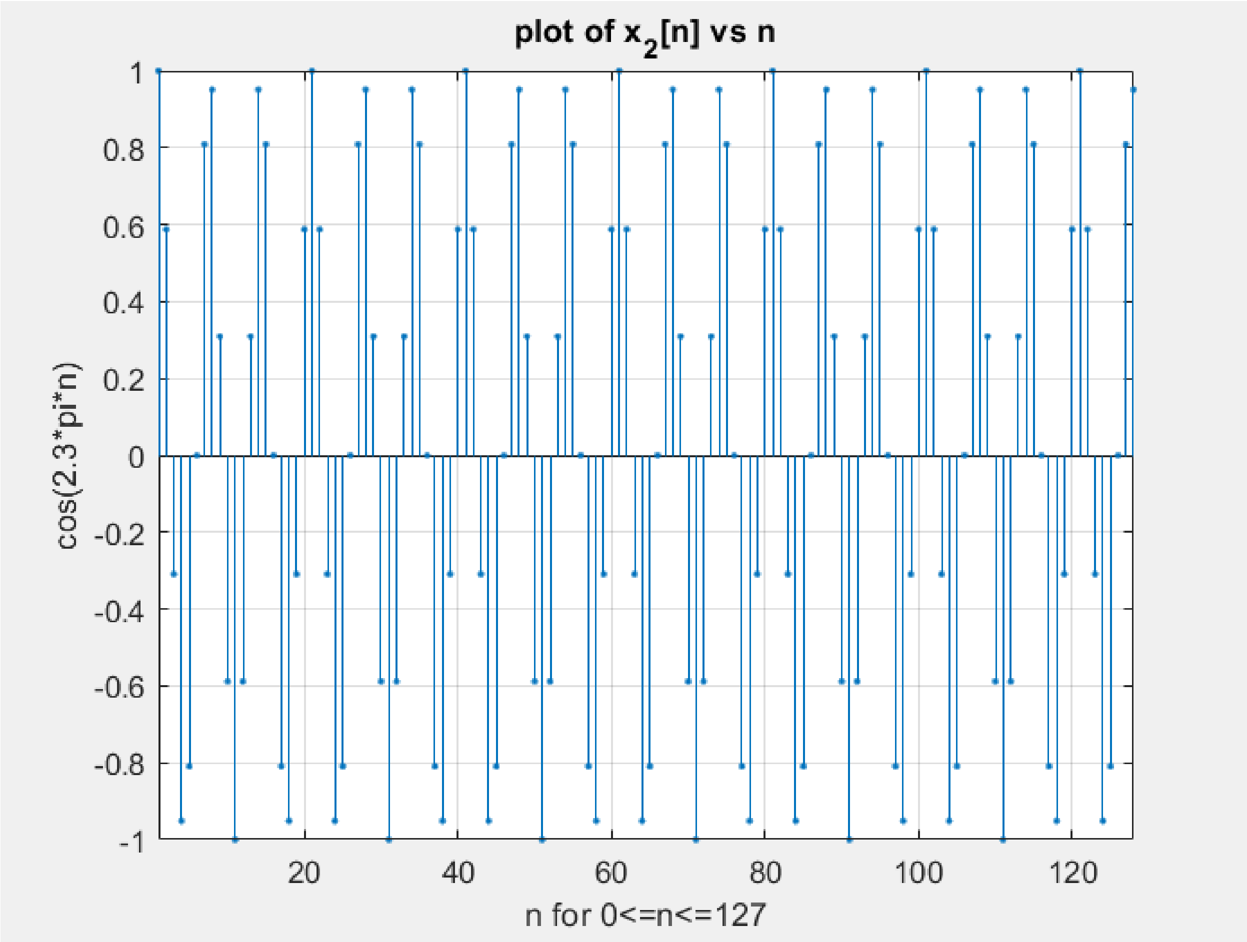

Figure-2) Plot of x_2[n] vs n

The value of ω is 2.3 π rad.

3-)

$$x_3\ [n] = \cos[-1.7\pi n]$$

3-a)

When x_3 is stored by computer, it had to be quantized. It is because x_3 is a continuous function in normal circumstances and some of their values are irrational. To store it in a small space it has been quantized.

Read and printed Results are:

```
x_3[2] : 0.588
x_3[8] : 0.951
x_3[111] : -1.000
x_3[127] : 0.809
```

3-b)

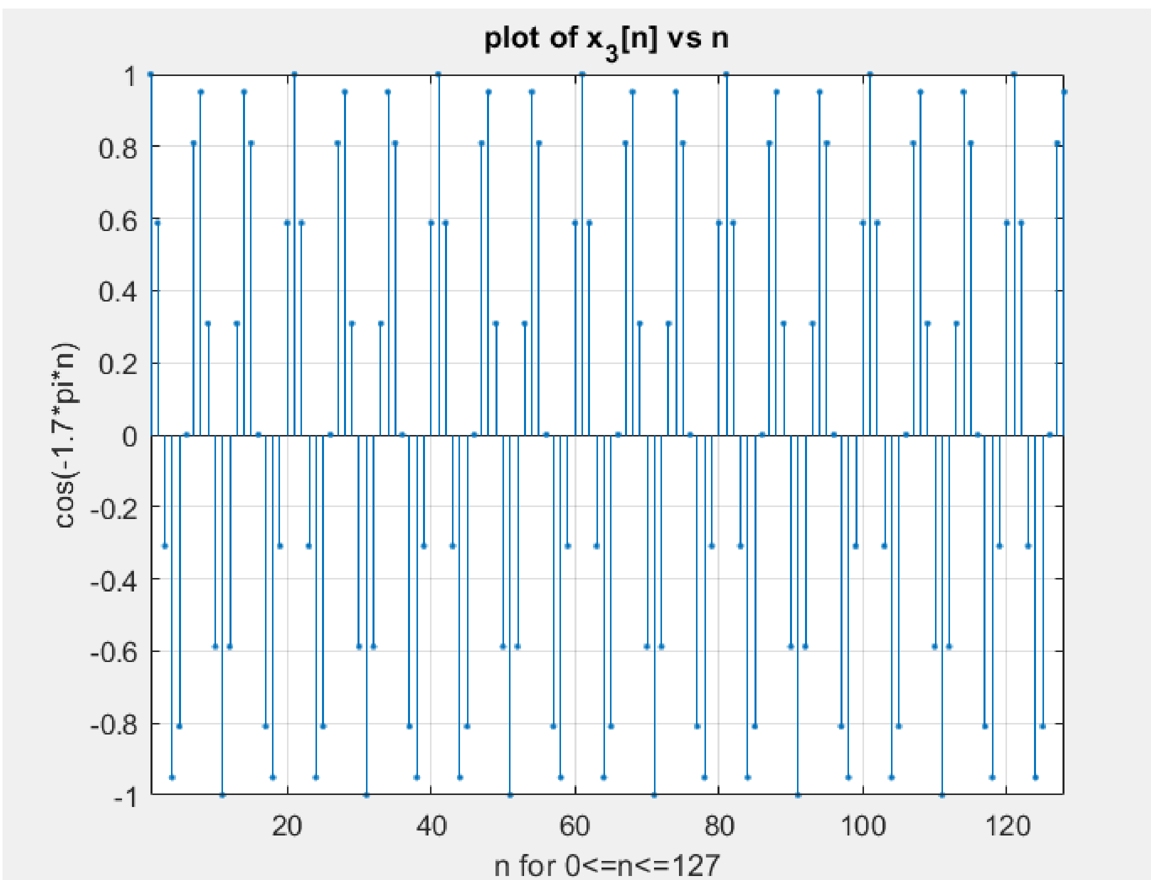

Figure-3) Plot of x_3[n] vs n

The value of ω is -1.7π rad.

Comparison of 2 and 3:

It is known that

$$\cos(a) = \cos(a + 2\pi k); k \in Z$$

Using this fact, it can be seen that

$$\cos(-1.7\pi n) = \cos(-1.7\pi n + 2\pi * 2)) = \cos(2.3\pi n)$$

That has been shown that x_2 and x_3 are equal to each other for any values of n.

4-)

$$x_4 [n] = \cos[0.24\pi n]$$

4-a)

When x_4 is stored by computer, it had to be quantized. It is because x_4 is a continuous function in normal circumstances and some of their values are irrational. To store it in a small space it has been quantized.

Read and printed Results are:

```
x_4[2] : 0.729
x_4[8] : 0.536
x_4[111] : 0.309
x_4[127] : 0.729
```

4-b)

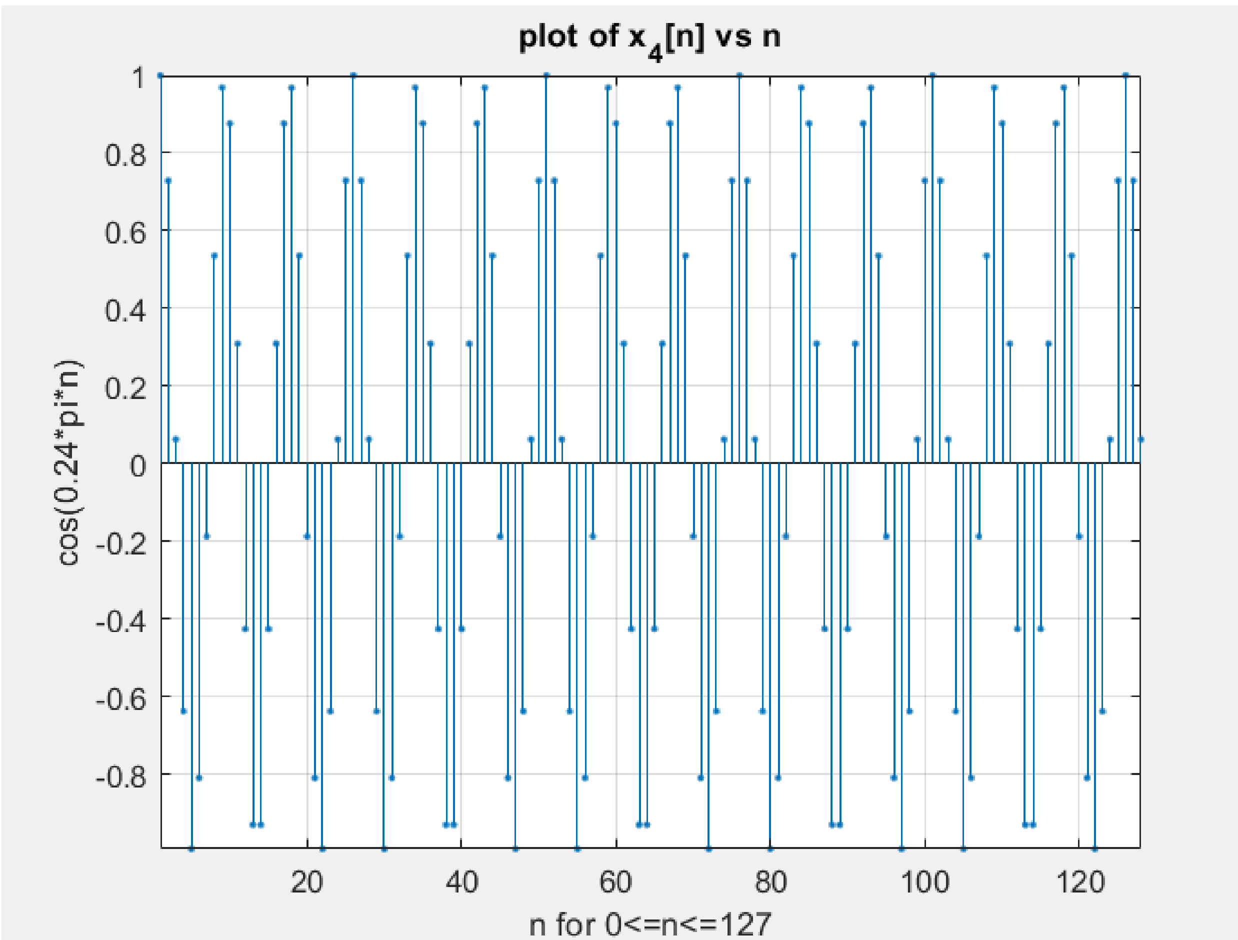

Figure-4) Plot of x_4[n] vs n

The value of ω is 0.24π rad.

5-)

$$x_5\,[n] = \cos[0.24\pi n+0.4]$$

5-a)

When x_5 is stored by computer, it had to be quantized. It is because x_5 is a continuous function in normal circumstances and some of their values are irrational. To store it in a small space it has been quantized.

Read and printed Results are:

```
x_5[2] : 0.405
x_5[8] : 0.822
x_5[111] : -0.086
x_5[127] : 0.405
```

5-b)

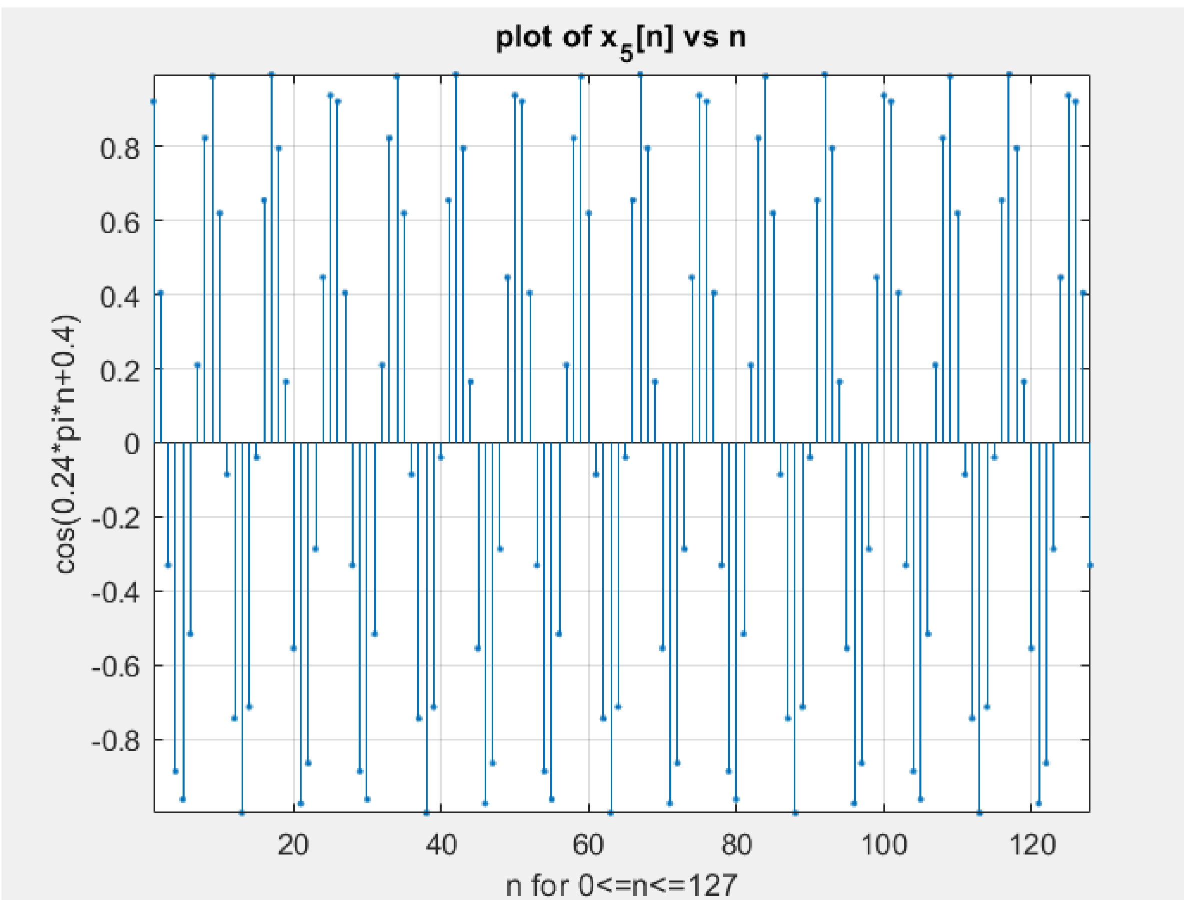

Figure-5) Plot of x_5[n] vs n

The value of ω is 0.24π rad.

Comparison of 4 and 5:

Normally it is known that adding constant value to inside of a function is just shifting, so if these functions were continuous functions, 5 would be the shifting version of 4 to the left. However, these functions are discrete. Even if5 is shifted version of 4 to the left, it cannot be said that 5 is perfectly shifted version of 4. It is because the shifting value (phase) is not an integer (0.4) and that's why values of these functions cannot be matched with this shifting.

6-)

$$x_6\,[n] = \cos[0.38\pi n]$$

6-a)

When x_6 is stored by computer, it had to be quantized. It is because x_6 is a continuous function in normal circumstances and some of their values are irrational. To store it in a small space it has been quantized.

Read and printed Results are:

```
x_6[2] : 0.368
x_6[8] : -0.482
x_6[111] : 0.809
x_6[127] : 0.930
```

6-b)

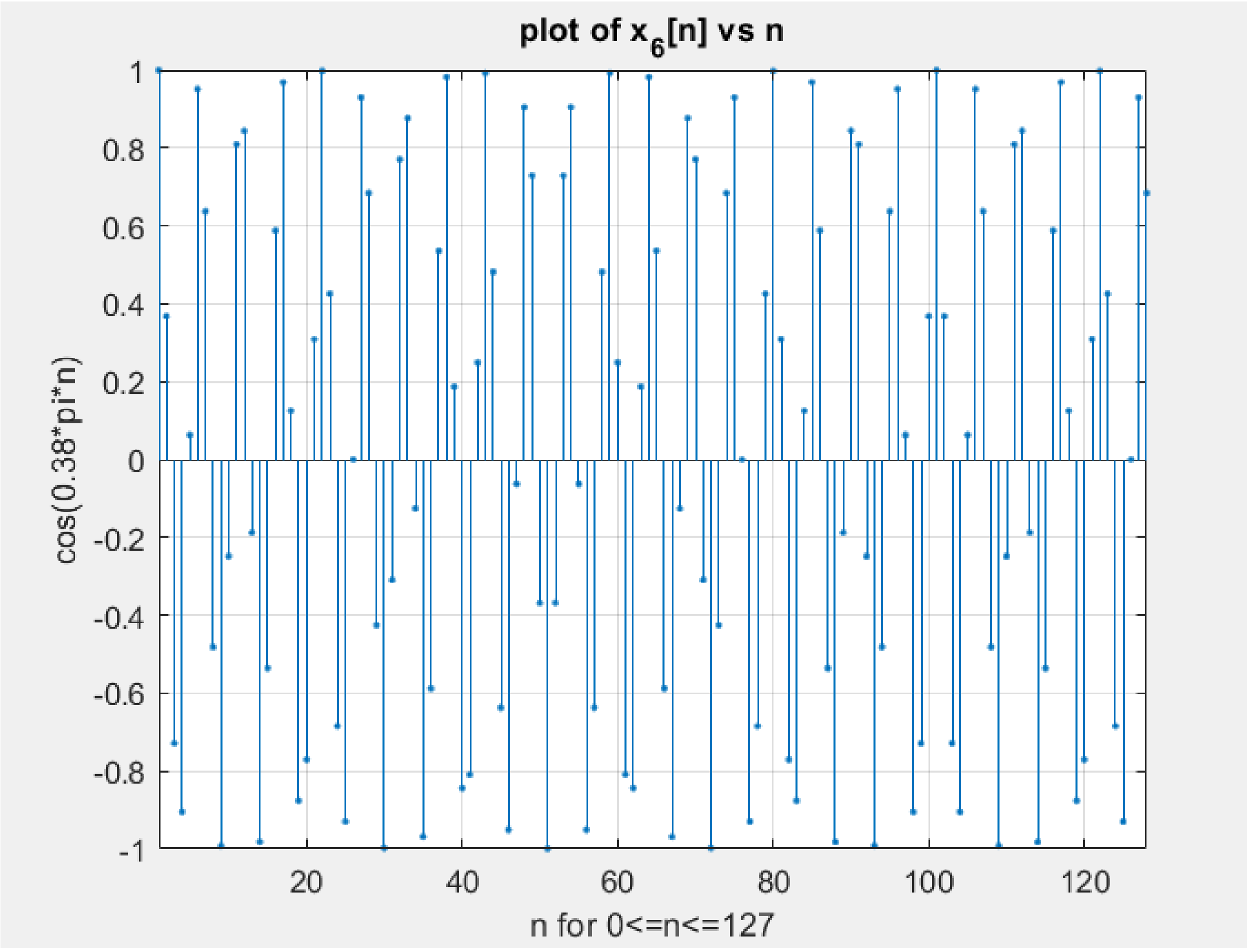

Figure-6) Plot of x_6[n] vs n

The value of ω is 0.38π rad.

7-)

$$x_7\,[n] = \cos[0.01\pi n]$$

7-a)

When x_7 is stored by computer, it had to be quantized. It is because x_7 is a continuous function in normal circumstances and some of their values are irrational. To store it in a small space it has been quantized.

Read and printed Results are:

```
x_7[2] : 1.000
x_7[8] : 0.976
x_7[111] : -0.951
x_7[127] : -0.685
```

7-b)

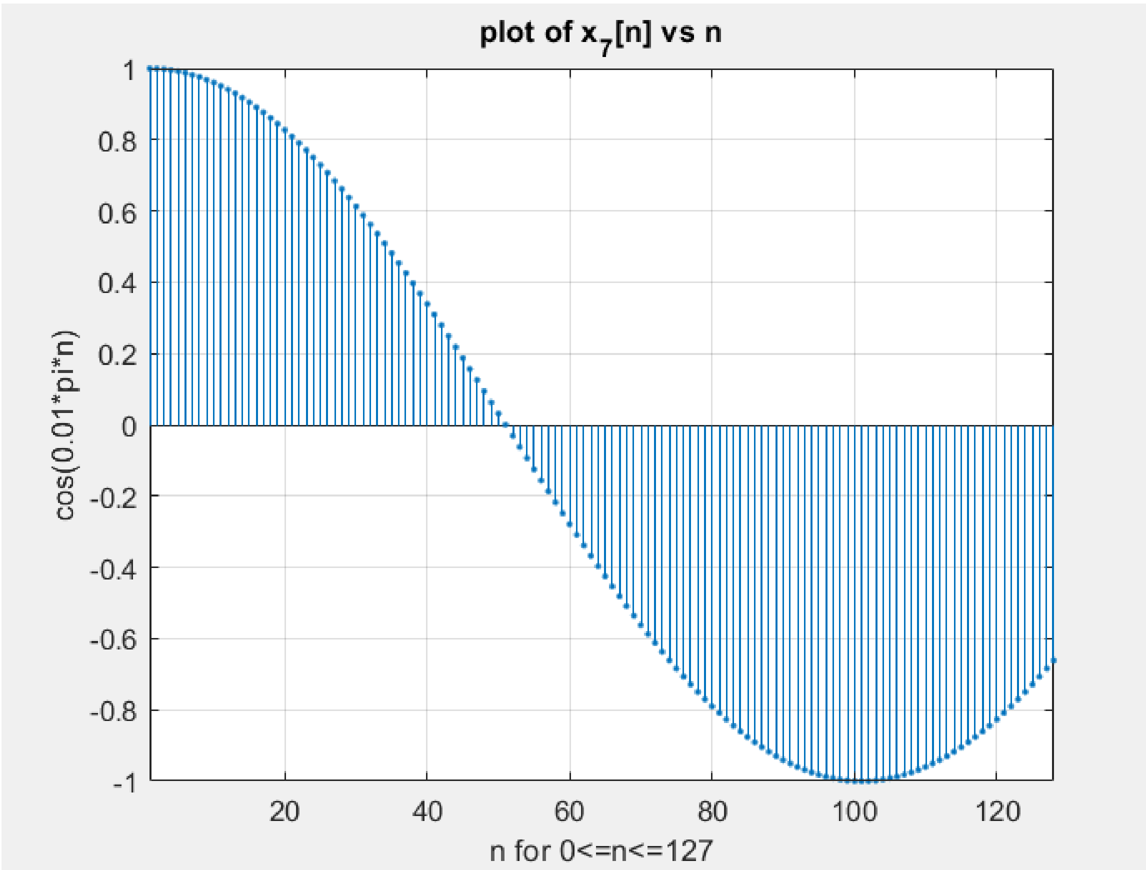

Figure-7) Plot of x_7[n] vs n

The value of ω is 0.01π rad.

8-)

$$x_8\,[n] = \cos[\pi n]$$

8-a)

When x_8 is stored by computer, it had to be quantized. It is because x_8 is a continuous function in normal circumstances and some of their values are irrational. To store it in a small space it has been quantized.

Read and printed Results are:

```
x_8[2] : -1.000
x_8[8] : -1.000
x_8[111] : 1.000
x_8[127] : 1.000
```

8-b)

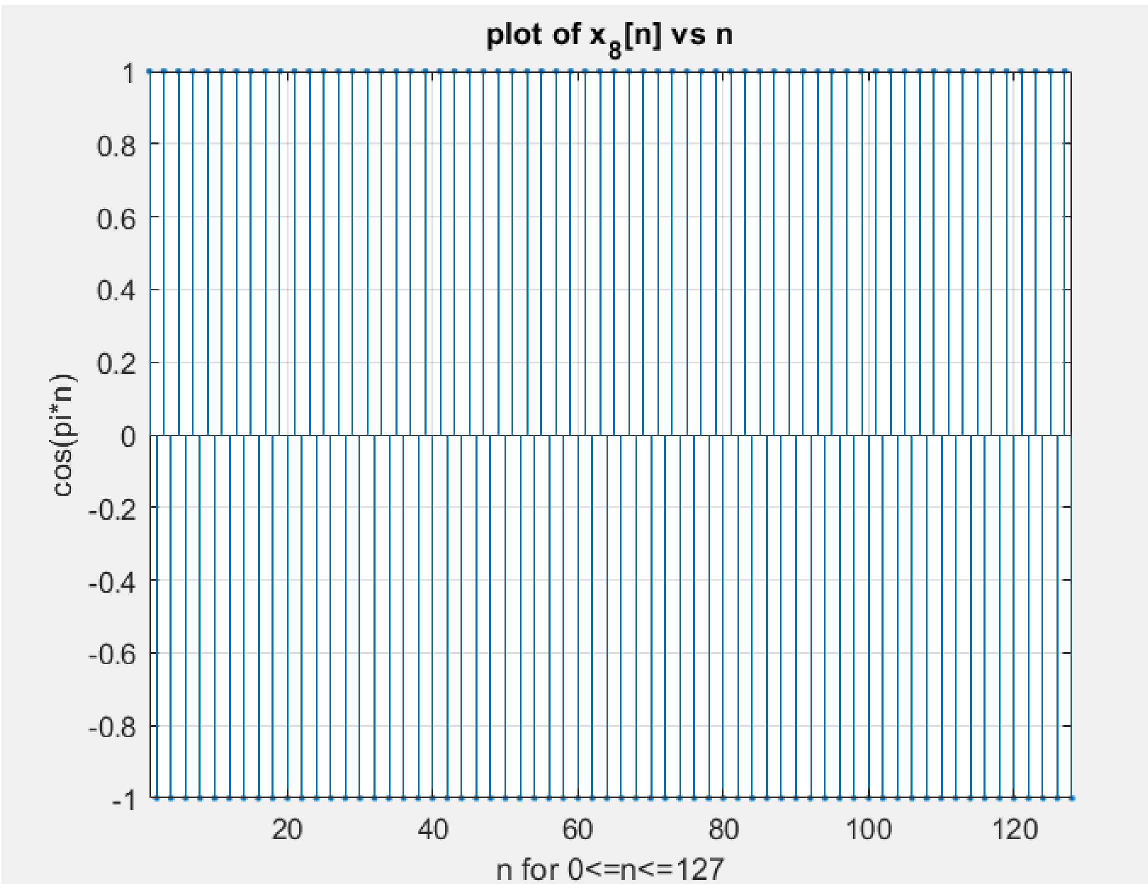

Figure-8) Plot of x_8[n] vs n

The value of ω is π rad.

9-)

$$x_9\,[n] = \cos[1.06\pi n]$$

9-a)

When x_9 is stored by computer, it had to be quantized. It is because x_9 is a continuous function in normal circumstances and some of their values are irrational. To store it in a small space it has been quantized.

Read and printed Results are:

```
x_9[2] : -0.982
x_9[8] : -0.249
x_9[111] : -0.309
x_9[127] : 0.187
```

9-b)

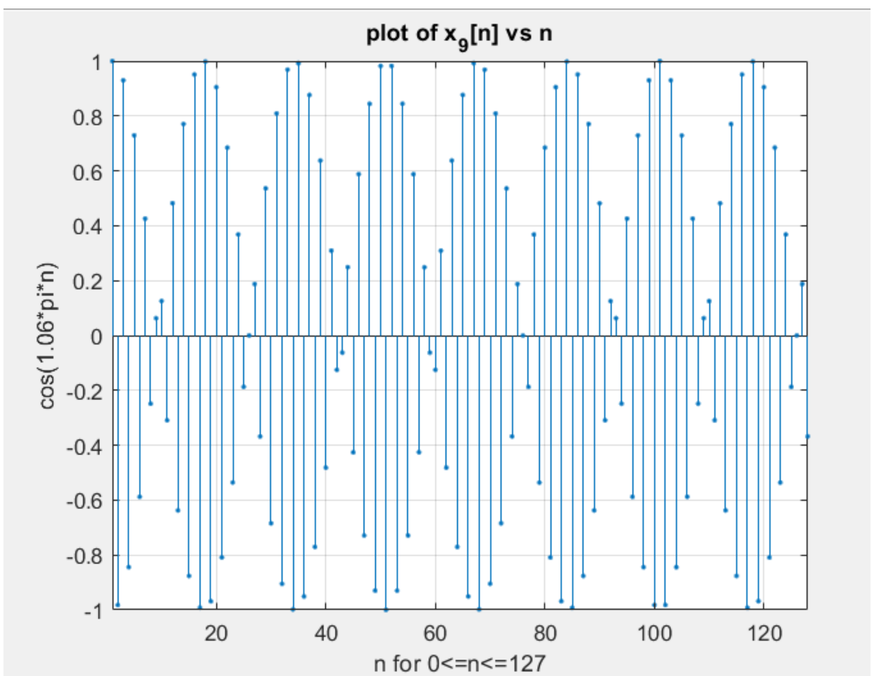

Figure-9) Plot of x_9[n] vs n

The value of ω is 1.06π rad.

10-)

$$x_{10}\,[n] = \cos[0.94\pi n]$$

10-a)

When x_{10} is stored by computer, it had to be quantized. It is because x_{11} is a continuous function in normal circumstances and some of their values are irrational. To store it in a small space it has been quantized.

Read and printed Results are:

```
x_10[2] : -0.982
x_10[8] : -0.249
x_10[111] : -0.309
x_10[127] : 0.187
```

10-b)

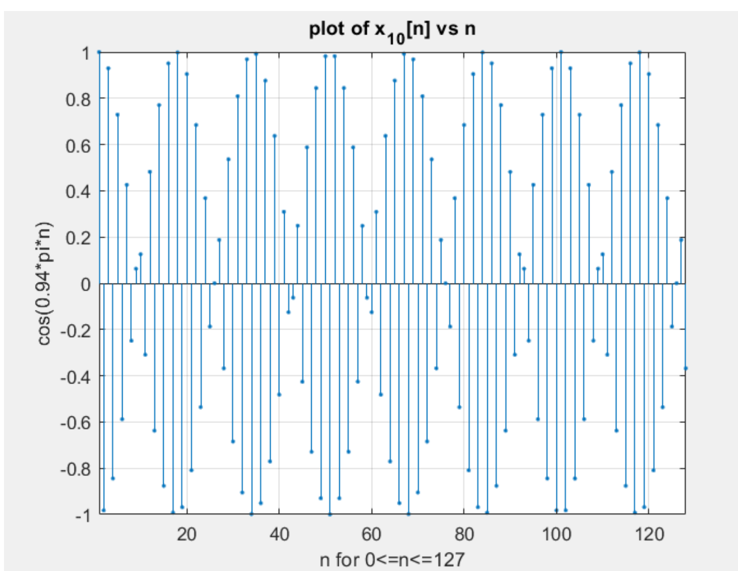

Figure-10) Plot of x_{10}[n] vs n

The value of ω is 0.94π rad.

Comparison of 9 and 10:

It is known that

$$\cos(\mathrm{a}) = \cos(\mathrm{a} + 2\pi \mathrm{k}); k \in Z$$

and

$$\cos(\mathrm{b}) = \cos(-b)$$

Using these facts, it can be seen that

$$\cos(0.94\pi \mathrm{n}) = \cos(-0.94\pi \mathrm{n}) = \cos(-0.94\pi \mathrm{n} + 2\pi \mathrm{n})) = \cos(1.06\pi \mathrm{n})$$

It has been shown that x_9 and x_{10} are equal to each other for any values of n

11-)

$$x_{11}[n] = \cos[n]$$

11-a)

When x_{11} is stored by computer, it had to be quantized. It is because x_{11} is a continuous function in normal circumstances and some of their values are irrational. To store it in a small space it has been quantized.

Read and printed Results are:

```
x_11[2] : 0.540
x_11[8] : 0.754
x_11[111] : -0.999
x_11[127] : 0.944
```

11-b)

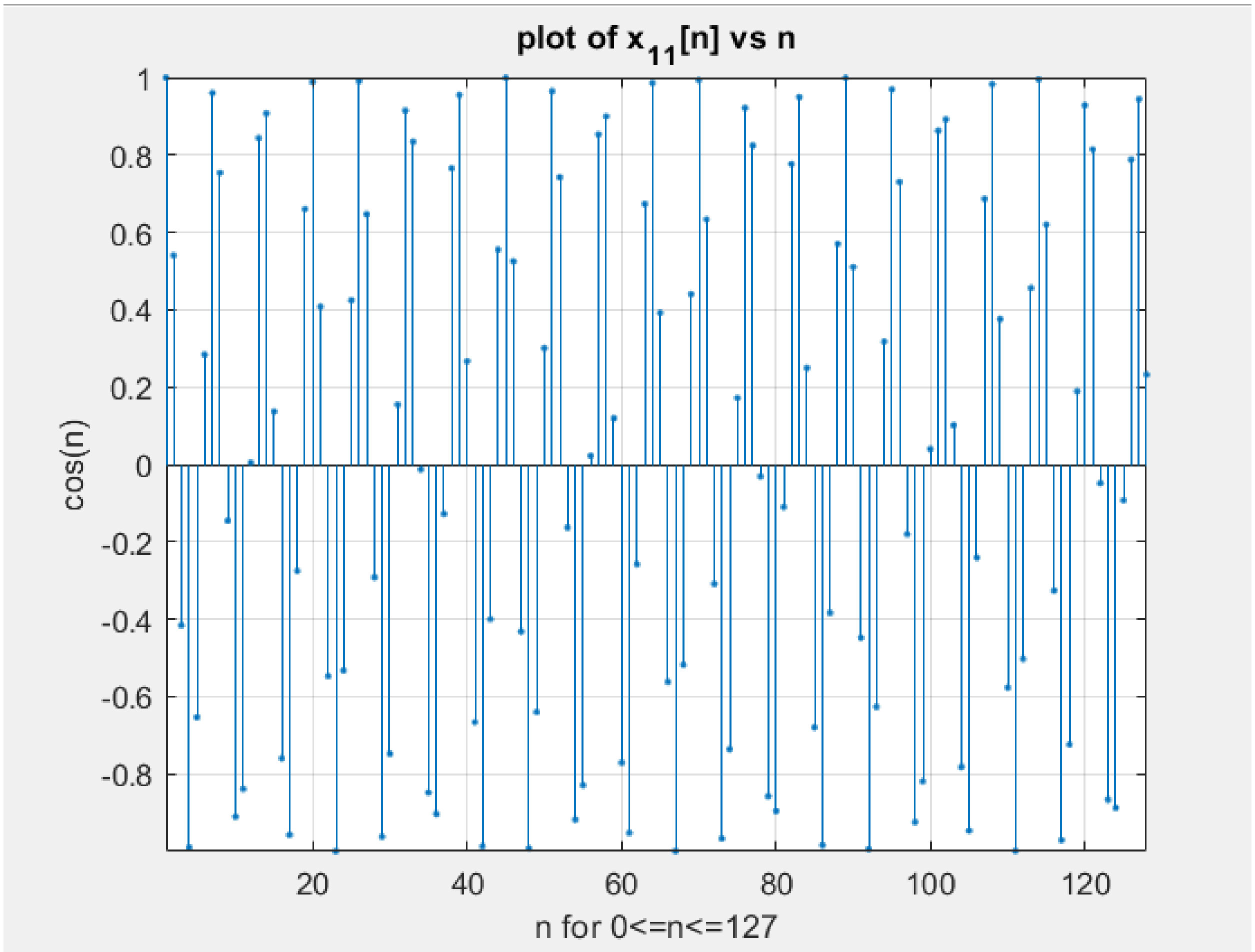

Figure-11) Plot of x_{11}[n] vs n

The value of ω is 1 rad.

12-)

$$x_{12}\,[n] = \cos[0.8n+0.3]$$

12-a)

When x_{12} is stored by computer, it had to be quantized. It is because x_{12} is a continuous function in normal circumstances and some of their values are irrational. To store it in a small space it has been quantized.

Read and printed Results are:

```
x_12[2] : 0.454
x_12[8] : 0.927
x_12[111] : 0.944
x_12[127] : 0.842
```

12-b)

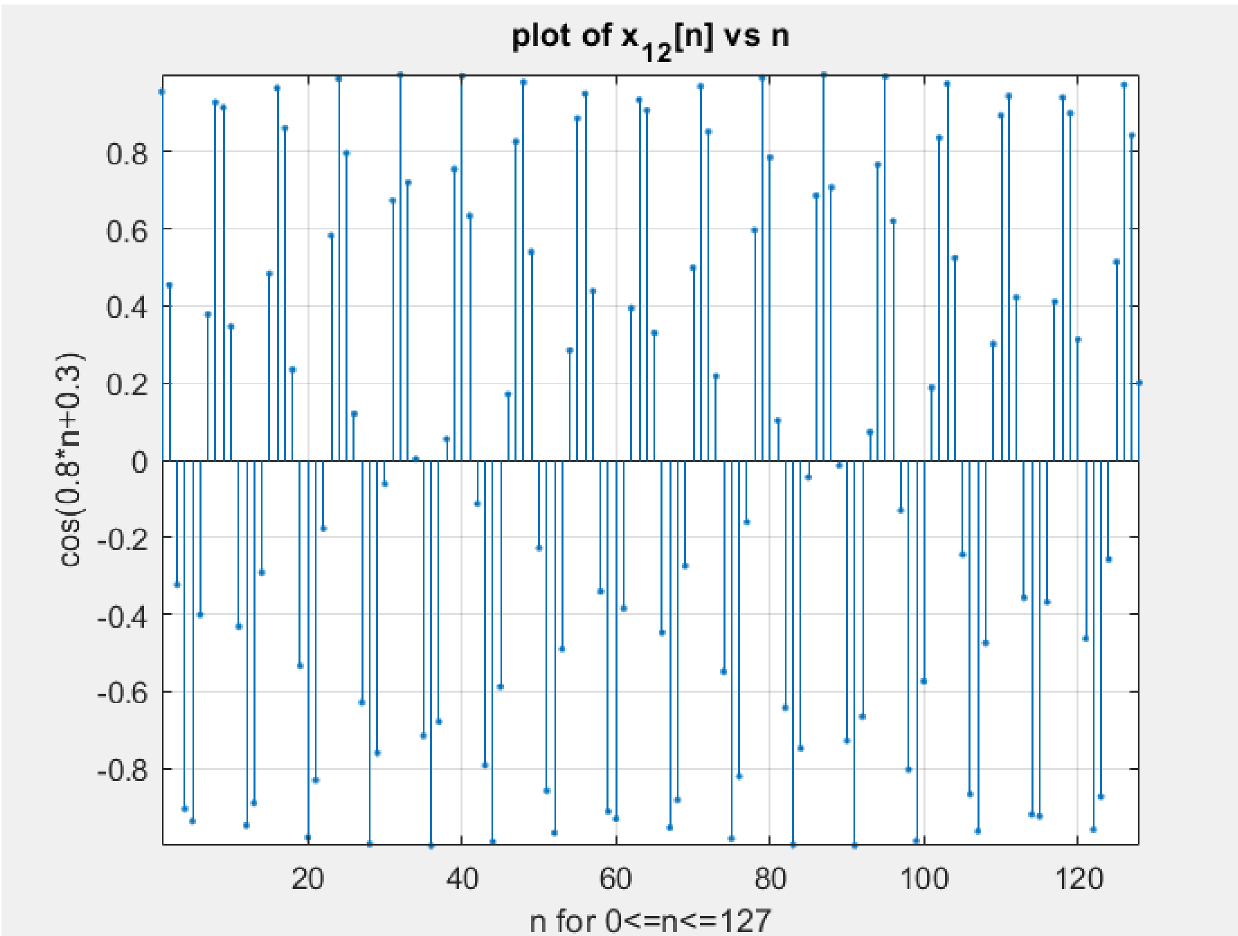

Figure-12) Plot of x_{12}[n] vs n

The value of ω is 0.8 rad.

<u>Before answering question 13, question 14 is going to be answered and using the answer to question 14, fundamental periods of signals will be found for question 13.</u>

14)

In the lab manual the information below was given.

A discrete signal $x[n]$ is said to be *periodic* if an integer N can be found, such that, $x[n+N] = x[n]$ for all n; in that case, N is a *period* of $x[n]$. Note that N, is not unique if it exists; minimum positive N is called the *fundamental period*. If a period cannot be found, as defined above, then the signal is not a periodic signal.

Then using the Euler's formula, we know that real part of complex function is a cosine function, which is X_i in this lab.

$$X_i[n] = Re\{e^{j\omega n}\} = X_i[n+N] = Re\{e^{j\omega(n+N)}\} = Re\{e^{j\omega N}e^{j\omega n}\}$$

The equation above gives that

$$e^{j\omega n} = e^{j\omega n} * e^{j\omega N}$$

Using this equation, we got the equation below.

$$e^{j\omega N} = 1$$

It is known that $\exp(2\pi * a)$=1, it implies that $\omega N = 2\pi a, \quad a \in Z$

$$\frac{\omega}{2\pi} = \frac{a}{N}$$

The last equation gives the needed information us, to have a period the equation must be satisfied. Since the right-hand side of the equation is rational number (both a and N are integer), the left-hand side must be rational as well. So must be in a such form that $\omega = \pi * b,$ b$\in R$. This is the needed condition for ω to satisfy the periodicity.

The minimum N that satisfies the last equation is the fundamental period of the signal.

13)

13.1) x_1[n] = cos[0.14πn]

According to rule found while answering question 14, $N = {}^{2\pi a}/_{\omega}$. According to this rule ${}^{2\pi a}/_{0.14\pi} = {}^{100a}/_{7} = N$. The smallest integer N that satisfies this condition is 100. Then it is seen that the fundamental period of x_1 is 100.

13.2) x_2 [n] = cos[2.3πn]

According to rule found while answering question 14, $N = {}^{2\pi a}/_{\omega}$. According to this rule ${}^{2\pi a}/_{2.3\pi} = {}^{20a}/_{23} = N$. The smallest integer N that satisfies this condition is 20. Then it is seen that the fundamental period of $x_2$is 20.

13.3) x_3 [n] = cos[-1.7πn]

According to rule found while answering question 14, $N = {}^{2\pi a}/_{\omega}$. According to this rule ${}^{2\pi a}/_{-1.7\pi} = {}^{20a}/_{-17} = N$. The smallest integer N that satisfies this condition is 20. Then it is seen that the fundamental period of $x_3$is 20.

13.4)x_4 [n] = cos[0.24πn]

According to rule found while answering question 14, $N = {}^{2\pi a}/_{\omega}$. According to this rule ${}^{2\pi a}/_{0.24\pi} = {}^{25a}/_{6} = N$. The smallest integer N that satisfies this condition is 25. Then it is seen that the fundamental period of $x_4$is 25.

13.5) x_5 [n] = cos[0.24πn+0.4]

According to rule found while answering question 14, $N = {}^{2\pi a}/_{\omega}$. According to this rule ${}^{2\pi a}/_{0.24\pi} = {}^{25a}/_{6} = N$. The smallest integer N that satisfies this condition is 25. Then it is seen that the fundamental period of $x_5$is 25.

13.6)x_6 [n] = cos[0.38πn]

According to rule found while answering question 14, $N = {}^{2\pi a}/_{\omega}$. According to this rule ${}^{2\pi a}/_{0.38\pi} = 19 = N$. The smallest integer N that satisfies this condition is 100. Then it is seen that the fundamental period of $x_6$is 100.

13.7) x_7 [n] = cos[0.01πn]

According to rule found while answering question 14, $N = {}^{2\pi a}/_{\omega}$. According to this rule ${}^{2\pi a}/_{0.01\pi} = {}^{200a}/_{1} = N$. The smallest integer N that satisfies this condition is 200. Then it is seen that the fundamental period of $x_7$is 200.

13.8) x_8 [n] = cos[πn]

According to rule found while answering question 14, $N = {}^{2\pi a}/_{\omega}$. According to this rule ${}^{2\pi a}/_{\pi} = {}^{2a}/_{1} = N$. The smallest integer N that satisfies this condition is 2. Then it is seen that the fundamental period of $x_8$is 2.

13.9) x_9 [n] = cos[1.06πn]

According to rule found while answering question 14, $N = {}^{2\pi a}/_{\omega}$. According to this rule ${}^{2\pi a}/_{1.06\pi} = {}^{100a}/_{53} = N$. The smallest integer N that satisfies this condition is 100. Then it is seen that the fundamental period of $x_9$is 100.

13.10) x_{10} [n] = cos[0.94πn]

According to rule found while answering question 14, $N = {}^{2\pi a}/_{\omega}$. According to this rule ${}^{2\pi a}/_{0.94\pi} = {}^{100a}/_{47} = N$. The smallest integer N that satisfies this condition is 100. Then it is seen that the fundamental period of $x_{10}$is 100.

13.11) x_{11} [n] = cos[n]

According to rule found while answering question 14, $N = {}^{2\pi a}/_{\omega}$. According to this rule ${}^{2\pi a}/_{1} = N$. There is no integer N that satisfies this condition. Then it is seen that x_{11} is not periodic.

13.12) x_{12} [n] = cos[0.8n+0.3]

According to rule found while answering question 14, $N = {}^{2\pi a}/_{\omega}$. According to this rule ${}^{2\pi a}/_{0.8} = N$. There is no integer N that satisfies this condition. Then it is seen that x_{12} is not periodic.

15)

It is known that 2π is the natural and fundamental period of any cosine signal and using this fact it is easily can be said that ${}^{2\pi}/_{\omega} = T\ (period)$ for any continuous cosine signal. Therefore, for a continuous cosine signal there is no periodicity condition. In other words, the period of a cosine signal is the interval between two maxima or two minima. However, if the signal is a discrete cosine signal, the period doesn't have to be the interval between two extrema. Instead of this rule there is another so that T must be integer and $\omega * T$ must be a multiple of 2π, mathematically $\omega * T = 2\pi a$; $a, T \in Z$, which was shown while answering question 14. This is because unlike continuous functions, all the variables that function can take is integer and so their intervals are integer as well. Since the period is one of those intervals, it must be an integer too.

Appendix

```
n=[0:127];

disp("-----------------------(1.a)----------------------")

temp_x_1=cos(0.14*pi*n);
writematrix(temp_x_1,"x_1.csv");
x_1=readmatrix("x_1.csv");
```

```
fprintf("x_1[2] : %0.3f \nx_1[8] : %0.3f\nx_1[111] : %0.3f\nx_1[127] : %0.3f \n",
x_1(2),x_1(8),x_1(111),x_1(127))

figure
stem(x_1,'.')
title('plot of x_1[n] vs n')
xlabel('n for 0<=n<=127')
ylabel('cos(0.14*pi*n)')
grid on
axis tight

fprintf("the value of w is %0.3f rad \n", 0.14*pi)
fprintf("the fundamental period is %0.f \n", 100)




disp("------------------------(2.a)------------------------")

temp_x_2=cos(2.3*pi*n);
writematrix(temp_x_2,"x_2.csv");
x_2=readmatrix("x_2.csv");
```

```
fprintf("x_2[2] : %0.3f \nx_2[8] : %0.3f\nx_2[111] : %0.3f\nx_2[127] : %0.3f\n",
x_2(2),x_2(8),x_2(111),x_2(127))

figure
stem(x_2,'.')
title('plot of x_2[n] vs n')
xlabel('n for 0<=n<=127')
ylabel('cos(2.3*pi*n)')
grid on
axis tight

fprintf("the value of w is %0.3f rad\n", 2.3*pi)
fprintf("the fundamental period is %0.f \n", 20)




disp("----------------------(3.a)----------------------")

temp_x_3=cos(-1.7*pi*n);
writematrix(temp_x_3,"x_3.csv");
x_3=readmatrix("x_3.csv");
fprintf("x_3[2] : %0.3f \nx_3[8] : %0.3f\nx_3[111] : %0.3f\nx_3[127] : %0.3f\n",
x_3(2),x_3(8),x_3(111),x_3(127))
```

```
figure

stem(x_3,'.')

title('plot of x_3[n] vs n')

xlabel('n for 0<=n<=127')

ylabel('cos(-1.7*pi*n)')

grid on

axis tight


fprintf("the value of w is %0.3f rad\n", -1.7*pi)

fprintf("the fundamental period is %0.f \n", 20)


disp("---------------Comparison (2) and (3)--------------")

disp("it is known that cos(a)=cos(a+2*pi*k)")

disp("using this fact, it can be seen that cos(-1.7*pi*n)=cos(-
1.7*pi*n+2*pi*(2n))=cos(2.3*pi*n)")

disp("it has been shown that x_2 and x_3 are equal to each other for any values of n")


disp("----------------------(4.a)----------------------")


temp_x_4=cos(0.24*pi*n);

writematrix(temp_x_4,"x_4.csv");

x_4=readmatrix("x_4.csv");
```

```
fprintf("x_4[2] : %0.3f \nx_4[8] : %0.3f\nx_4[111] : %0.3f\nx_4[127] : %0.3f\n",
x_4(2),x_4(8),x_4(111),x_4(127))

figure
stem(x_4,'.')
title('plot of x_4[n] vs n')
xlabel('n for 0<=n<=127')
ylabel('cos(0.24*pi*n)')
grid on
axis tight

fprintf("the value of w is %0.3f rad\n", 0.24*pi)
fprintf("the fundamental period is %0.f \n", 25)


disp("-----------------------(5.a)-----------------------")

temp_x_5=cos(0.24*pi*n+0.4);
writematrix(temp_x_5,"x_5.csv");
x_5=readmatrix("x_5.csv");
fprintf("x_5[2] : %0.3f \nx_5[8] : %0.3f\nx_5[111] : %0.3f\nx_5[127] : %0.3f\n",
x_5(2),x_5(8),x_5(111),x_5(127))
```

```
figure
stem(x_5,'.')
title('plot of x_5[n] vs n')
xlabel('n for 0<=n<=127')
ylabel('cos(0.24*pi*n+0.4)')
grid on
axis tight

fprintf("the value of w is %0.3f rad\n", 0.24*pi)
fprintf("the fundamental period is %0.f \n", 25)

disp("---------------Comparison (4) and (5)---------------")
disp("normally it is known that adding constant value to inside of a function is just shifting")
disp("so if these functions were continuous functions, 5 would be the shifting version of 4 to the left")
disp("however these functions are discrete")
disp("even if they have same period and of course same periods, it cannot be said that 5 is shifted version of 4")
disp("it is because the shifting value is not an integer (0.4) and that's why values of these functions cannot be matched with this shifting")
```

```
disp("-----------------------(6.a)-----------------------")


temp_x_6=cos(0.38*pi*n);

writematrix(temp_x_6,"x_6.csv");

x_6=readmatrix("x_6.csv");

fprintf("x_6[2] : %0.3f \nx_6[8] : %0.3f\nx_6[111] : %0.3f\nx_6[127] : %0.3f\n",

x_6(2),x_6(8),x_6(111),x_6(127))


figure

stem(x_6,'.')

title('plot of x_6[n] vs n')

xlabel('n for 0<=n<=127')

ylabel('cos(0.38*pi*n)')

grid on

axis tight


fprintf("the value of w is %0.3f rad\n", 0.38*pi)

fprintf("the fundamental period is %0.f \n", 100)
```

```
disp("----------------------(7.a)----------------------")


temp_x_7=cos(0.01*pi*n);

writematrix(temp_x_7,"x_7.csv");

x_7=readmatrix("x_7.csv");

fprintf("x_7[2] : %0.3f \nx_7[8] : %0.3f\nx_7[111] : %0.3f\nx_7[127] : %0.3f\n",

x_7(2),x_7(8),x_7(111),x_7(127))


figure

stem(x_7,'.')

title('plot of x_7[n] vs n')

xlabel('n for 0<=n<=127')

ylabel('cos(0.01*pi*n)')

grid on

axis tight


fprintf("the value of w is %0.3f rad\n", 0.01*pi)

fprintf("the fundamental period is %0.f \n", 200)




disp("----------------------(8.a)----------------------")
```

```
temp_x_8=cos(pi*n);

writematrix(temp_x_8,"x_8.csv");

x_8=readmatrix("x_8.csv");

fprintf("x_8[2] : %0.3f \nx_8[8] : %0.3f\nx_8[111] : %0.3f\nx_8[127] : %0.3f\n",
x_8(2),x_8(8),x_8(111),x_8(127))


figure

stem(x_8,'.')

title('plot of x_8[n] vs n')

xlabel('n for 0<=n<=127')

ylabel('cos(pi*n)')

grid on

axis tight


fprintf("the value of w is %0.3f rad\n", pi)

fprintf("the fundamental period is %0.f \n", 2)




disp("------------------------(9.a)------------------------")


temp_x_9=cos(1.06*pi*n);

writematrix(temp_x_9,"x_9.csv");
```

```
x_9=readmatrix("x_9.csv");

fprintf("x_9[2] : %0.3f \nx_9[8] : %0.3f\nx_9[111] : %0.3f\nx_9[127] : %0.3f\n",

x_9(2),x_9(8),x_9(111),x_9(127))


figure

stem(x_9,'.')

title('plot of x_9[n] vs n')

xlabel('n for 0<=n<=127')

ylabel('cos(1.06*pi*n)')

grid on

axis tight


fprintf("the value of w is %0.3f rad\n", 1.06*pi)

fprintf("the fundamental period is %0.f \n", 100)




disp("-----------------------(10.a)-----------------------")


temp_x_10=cos(0.94*pi*n);

writematrix(temp_x_10,"x_10.csv");

x_10=readmatrix("x_10.csv");
```

```
fprintf("x_10[2] : %0.3f \nx_10[8] : %0.3f\nx_10[111] : %0.3f\nx_10[127] : %0.3f\n",
x_10(2),x_10(8),x_10(111),x_10(127))

figure
stem(x_10,'.')
title('plot of x_1_0[n] vs n')
xlabel('n for 0<=n<=127')
ylabel('cos(0.94*pi*n)')
grid on
axis tight

fprintf("the value of w is %0.3f rad\n", 0.94*pi)
fprintf("the fundamental period is %0.f \n", 100)

disp("---------------Comparison (9) and (10)---------------")
disp("it is know that cos(a)=cos(a+2*pi*k) and cos(b)=cos(-b)")
disp("using these facts, it can be seen that cos(0.94*pi*n)=cos(-0.94*pi*n)=cos(-
0.94*pi*n+2*pi*n)=cos(1.06*pi*n)")
disp("it has been shown that x_9 and x_10 are equal to each other for any values of n")



disp("----------------------(11.a)----------------------")
```

```
temp_x_11=cos(n);

writematrix(temp_x_11,"x_11.csv");

x_11=readmatrix("x_11.csv");

fprintf("x_11[2] : %0.3f \nx_11[8] : %0.3f\nx_11[111] : %0.3f\nx_11[127] : %0.3f\n",
x_11(2),x_11(8),x_11(111),x_11(127))


figure

stem(x_11,'.')

title('plot of x_1_1[n] vs n')

xlabel('n for 0<=n<=127')

ylabel('cos(n)')

grid on

axis tight


fprintf("the value of w is %0.3f rad\n", 1)

fprintf("it is not periodic since there is no integer k or period for the equation k*2*pi=period*n
\n")




disp("-----------------------(12.a)-----------------------")


temp_x_12=cos(0.8*n+0.3);
```

```
writematrix(temp_x_12,"x_12.csv");

x_12=readmatrix("x_12.csv");

fprintf("x_12[2] : %0.3f \nx_12[8] : %0.3f\nx_12[111] : %0.3f\nx_12[127] : %0.3f \n",

x_12(2),x_12(8),x_12(111),x_12(127))


figure

stem(x_12,'.')

title('plot of x_1_2[n] vs n')

xlabel('n for 0<=n<=127')

ylabel('cos(0.8*n+0.3)')

grid on

axis tight


fprintf("the value of w is %0.3f rad\n", 0.8)

fprintf("it is not periodic since there is no integer k or period for the equation k*2*pi=0.8*period

\n\n")




fprintf("14) to have a period for discrete signals w must satisfy that T(period) must be an integer

and w*(T)period must be a multiple of 2*pi \n\n")

disp("15) it is known that 2pi is the natural and fundamental period of a cosine signal,")

disp("and using this fact it is easily can be said that 2pi/w=T(period) for a continuous cosine")
```

disp("so for continuous cosine signals there is no periodicity condition ")

disp("however if the signal is a discrete cosine signal period must be integer and so w*T(period) must be a multiple of 2pi: w*T=k*2pi; k and T are integers")

disp("this is because unlike continuous functions, all the units function can take is integer and so their intervals are integer as well")

disp("since the period is one of those intervals, it must be an integer as well")

save lab_1.mat

load lab_1.mat