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Experiment 3	
AIM	The aim of this experiment is to study magnitude spectrum of the DT signal.
OBJECTIVE:	1. Develop a function to perform DFT of N point signal 2. Calculate DFT of a DT signal and Plot Spectrum of Signal. 3. Calculate the effect of zero padding on magnitude spectrum.
INPUT SPECIFICATIONS:	1. Length of first Signal N 2. Signal values.
PROBLEM DEFINITION:	1) Take any four-point sequence x[n]. Find DFT X[k]. Plot Magnitude Spectrum. (2) Append the input signal by four zeros. Find DFT and plot Magnitude Spectrum Give your conclusion. (3) Expand the input signal by inserting alternate zero. Find DFT and plot Magnitude Spectrum Give your conclusion. (4) Expand the signal x[n] by alternate Two zeros. Find DFT and plot Magnitude Spectrum Give your conclusion.

RESULT:

Case 1: To find DFT of 4-point sequence

Input: x[n]= {1,2,3,4} Length N=4

Output: X[k]

|X[k]|= {10,2.83,2,2.83}

```
PS C:\Users\aspur\OneDrive\FOSIP\Programs> gcc .\DFT.c
PS C:\Users\aspur\OneDrive\FOSIP\Programs> .\a.exe

 Enter the length of x[n] ie N = 4
Enter the values of x[n] : 1 2 3 4

 X[k] by DFT :
  10.00 +j    0.00
  -2.00 +j    2.00
  -2.00 +j   -0.00
  -2.00 +j   -2.00


 x[n] by IDFT :
   1.00 + j    0.00
   2.00 + j    0.00
   3.00 + j   -0.00
   4.00 + j    0.00

PS C:\Users\aspur\OneDrive\FOSIP\Programs>
```

Case 2: To find DFT of zero padded signal.

Input: x[n]= {1,2,3,4,0,0,0,0} Length N=8

Output: X[k]

|X[k]|= {10,7.25,2.83,2.72,2.72,2.83,7.25}

```
● PS C:\Users\aspur\OneDrive\FOSIP\Programs> .\a.exe

  Enter the length of x[n] ie N = 8
 Enter the values of x[n] : 1 2 3 4 0 0 0 0

  X[k] by DFT :
   10.00 +j    0.00
   -0.41 +j   -7.24
   -2.00 +j    2.00
    2.41 +j   -1.24
   -2.00 +j   -0.00
    2.41 +j    1.24
   -2.00 +j   -2.00
   -0.41 +j    7.24


  x[n] by IDFT :
    1.00 + j    0.00
    2.00 + j    0.00
    3.00 + j   -0.00
    4.00 + j    0.00
    0.00 + j   -0.00
    0.00 + j   -0.00
   -0.00 + j   -0.00
   -0.00 + j   -0.00

○ PS C:\Users\aspur\OneDrive\FOSIP\Programs>
```

Case 3: To find DFT of expanded signal.
Input: x[n]= {1,0,2,0,3,0,4,0} Length N=8
Output: X[k]
|X[k]|= {10,2.83,2,2.83,10,2.83,2,2.83}

```
PS C:\Users\aspur\OneDrive\FOSIP\Programs> .\a.exe

 Enter the length of x[n] ie N = 8
Enter the values of x[n] : 1 0 2 0 3 0 4 0

 X[k] by DFT :
  10.00 +j    0.00
  -2.00 +j    2.00
  -2.00 +j   -0.00
  -2.00 +j   -2.00
  10.00 +j   -0.00
  -2.00 +j    2.00
  -2.00 +j    0.00
  -2.00 +j   -2.00


 x[n] by IDFT :
   1.00 + j    0.00
   0.00 + j    0.00
   2.00 + j    0.00
   0.00 + j    0.00
   3.00 + j   -0.00
   0.00 + j   -0.00
   4.00 + j   -0.00
   0.00 + j   -0.00

PS C:\Users\aspur\OneDrive\FOSIP\Programs>
```

Case 4: To find DFT of expanded signal
Input: x[n]= {1,0,0,2,0,0,3,0,0,4,0,0} Length N=12
Output: X[k]
|X[k]|= {10,2.83,2,2.83,10,2.83,2,2.83,,10,2.83,2,2.83}

```
PS C:\Users\aspur\OneDrive\FOSIP\Programs> .\a.exe

 Enter the length of x[n] ie N = 12
Enter the values of x[n] : 1 0 0 2 0 0 3 0 0 4 0 0

 X[k] by DFT :
  10.00 +j    0.00
  -2.00 +j    2.00
  -2.00 +j   -0.00
  -2.00 +j   -2.00
  10.00 +j   -0.00
  -2.00 +j    2.00
  -2.00 +j    0.00
  -2.00 +j   -2.00
  10.00 +j   -0.00
  -2.00 +j    2.00
  -2.00 +j   -0.00
  -2.00 +j   -2.00


 x[n] by IDFT :
   1.00 + j    0.00
   0.00 + j   -0.00
  -0.00 + j    0.00
   2.00 + j    0.00
   0.00 + j   -0.00
   0.00 + j   -0.00
   3.00 + j   -0.00
  -0.00 + j   -0.00
   0.00 + j   -0.00
   4.00 + j   -0.00
  -0.00 + j    0.00
  -0.00 + j   -0.00

PS C:\Users\aspur\OneDrive\FOSIP\Programs>
```

CONCLUSION:

1. **Domain Conversion**: The Discrete Fourier Transform (DFT) transforms a sequence from the time domain to the frequency domain.

2. **Sample Conversion**: DFT changes N samples in the time domain into N coefficients in the frequency domain.
3. **Frequency Coefficient Separation**: The separation between frequency domain coefficients is given by $w = 2\pi / N$.
4. **Effects of Increasing Signal Length (N)**:

   a) The spacing between frequencies decreases.

   b) The error in spectrum representation reduces.

   c) The resolution of the spectrum (i.e., number of points per unit length) increases, enhancing the accuracy of the spectrum representation.

5. **Time Domain Expansion and Frequency Domain Compression**: If the signal is expanded in the time domain, the spectrum is compressed in the frequency domain. In other words, an expansion in the time domain by a factor corresponds to a compression of the signal in the frequency domain by the same factor.