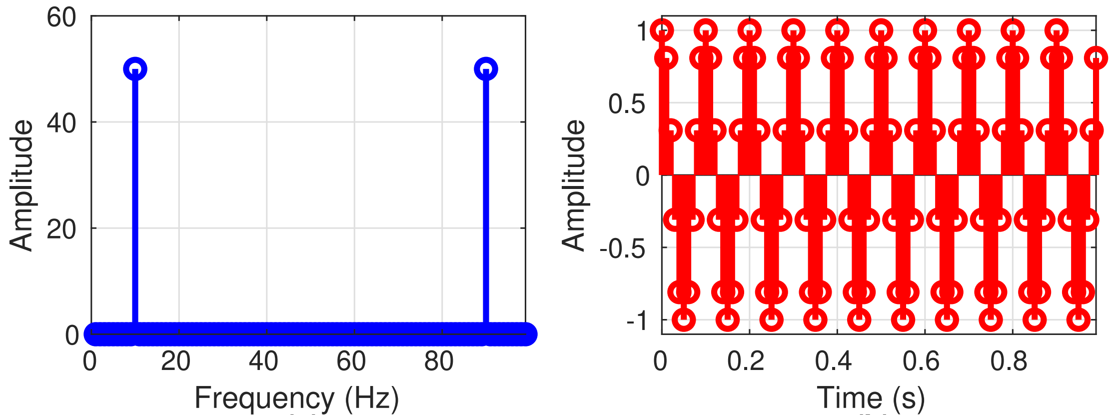
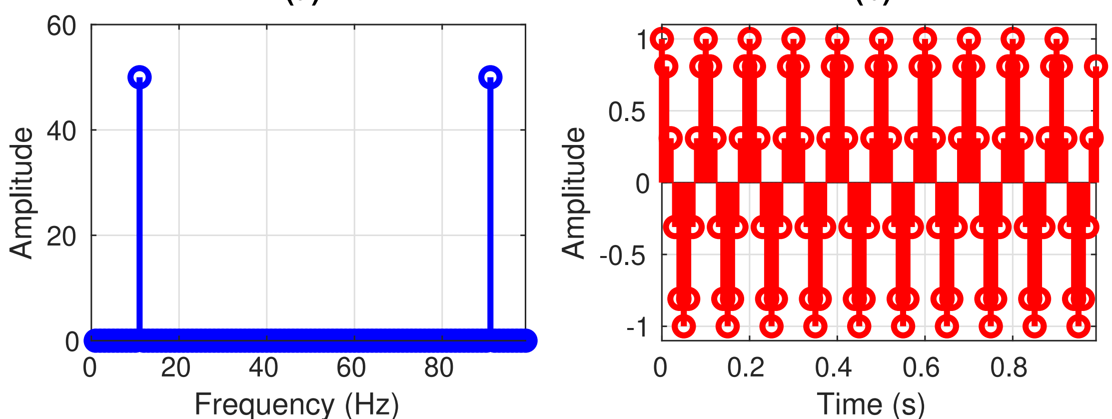
ICE503 Homework-08

Arnav Mukhopadhyay (D123070002)
EMAIL: gudduarnav@gmail.com

Q. 3



(a) (b)



(c) (d)

(a)

Given sequence is $\mathbf{x}(t) = \cos(2\pi \times 10 \times t)$. The twiddle factor matrix is obtained to obtain the DFT of this sequence. The (p, q)-th element of the matrix is written is $[\mathbf{W}]_{(p,q)} = e^{-j\frac{2\pi}{N}pq}$, with $N = 100$, since the sample rate is 100 Hz, and the signal is sampled for 1 seconds, thereby, generating 100 samples. Hence the resultant DFT is now obtained by the formula: $\mathbf{X}[k] = \mathbf{W}\mathbf{x}$. The corresponding plot is shown in Fig. (a) above.

(b)

IDFT is obtained by multiplying the scaled version hermitian of the twiddle matrix to the DFT sequence as, $\hat{\mathbf{x}}(n) = \frac{1}{N}\mathbf{W}^{-1}\mathbf{X}(k) = \frac{1}{N}\mathbf{W}^{H}\mathbf{X}(k)$. The corresponding plot is shown in Fig. (b) above.

(c)

Taking $\hat{\mathbf{X}}(k) = fft(\mathbf{x}(n))$ produces the frequency spectrum as shown in Fig. (c) above. However, due to a limited number of samples, there will be a slight difference in the frequency values obtained from the DFT matrix method.

(d)

Taking $ifft(\mathbf{X}(k))$ restores the time domain samples as shown in Fig. (d) above.