Assignment - 2

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① Find X(k) by DIT FFT Algorithm, of given $x(n)=\{0,1,2,3,4,5,6,7\}$

⇒ N=8, ∴ M=3.

Twiddle Factor for each stage $K=\frac{Nt}{2^m}$; $t=0,1,2,\ldots 2^{m-1}-1$

(i) For stage 1, m=1, t=0

$K=\frac{8\times0}{2^1}=0 \quad \therefore W_8^0 = e^{-j\frac{2\pi\times0}{8}} = 1$

(ii) For stage 2, m=2, t=0,1.

$\therefore K=\frac{8\times0}{2^2}=0 \quad \therefore W_8^0 = 1$

$\therefore K=\frac{8\times1}{2^2}=2 \quad \therefore W_8^2 = e^{-j\pi/2} = -j$

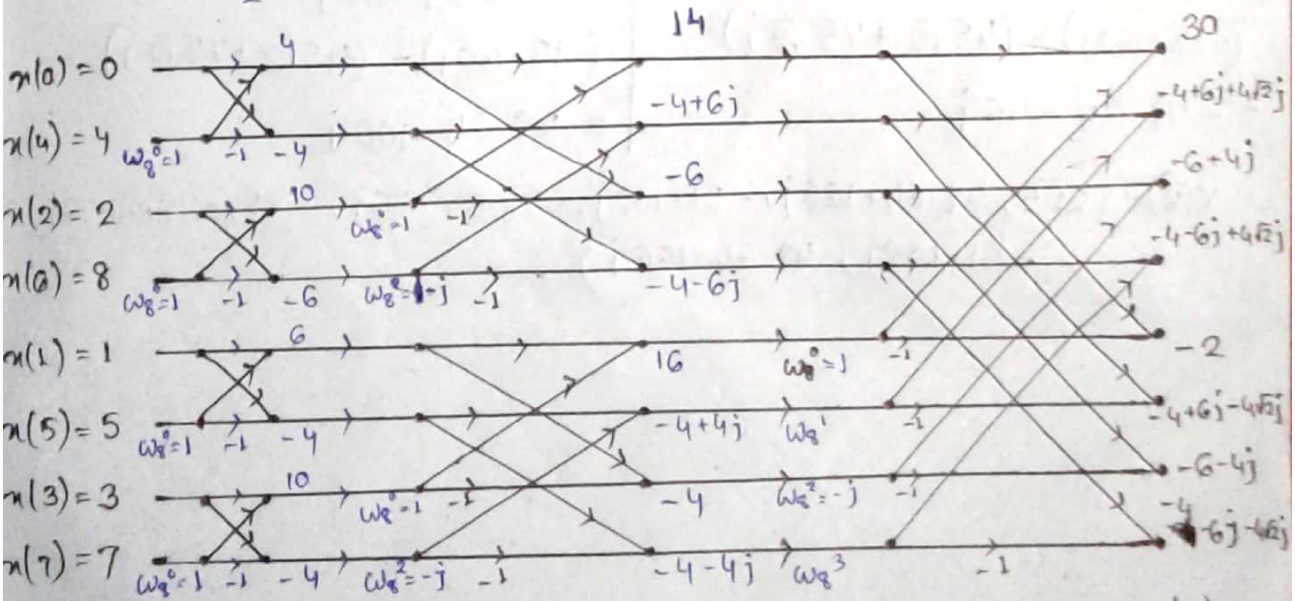
(iii) For stage 3, m=3, t=0,1,2,3.

$\therefore K=\frac{8\times0}{2^3}=0 \quad \therefore W_8^0 = 1$

$\therefore K=\frac{8\times1}{2^3}=1 \quad \therefore W_8^1 = e^{-j\pi/4} = 0.707 - j0.707$

$\therefore K=\frac{8\times2}{2^3}=2 \quad \therefore W_8^2 = -j$

$\therefore K=\frac{8\times3}{2^3}=3 \quad \therefore W_8^3 = e^{-j3\pi/4} = -0.707 - j0.707.$



$(-4+6j)+(-4+4j)\left(\frac{1}{\sqrt{2}}-j\frac{1}{\sqrt{2}}\right)$

$=(-4+6j)+(-2\sqrt{2}+2\sqrt{2}+2\sqrt{2}j+2\sqrt{2}j)$

$=(-4+6j)+4\sqrt{2}j$

$(-4-6j)+(-4-4j)\left(-\frac{1}{\sqrt{2}}-j\frac{1}{\sqrt{2}}\right)$

$=(-4-6j)+(4+4j)\left(\frac{1}{\sqrt{2}}+j\frac{1}{\sqrt{2}}\right)$

$=(-4-6j)+(2\sqrt{2}+2\sqrt{2}j+2\sqrt{2}j-2\sqrt{2})$

$=(-4-6j)+4\sqrt{2}j \qquad -4-(6+4\sqrt{2})j$

$\therefore X(k)=\{30, -4+(6+4\sqrt{2})j, -6+4j, -4-(6-4\sqrt{2})j, -2, -4+(6-4\sqrt{2}j), -6-4j, \ldots\}$

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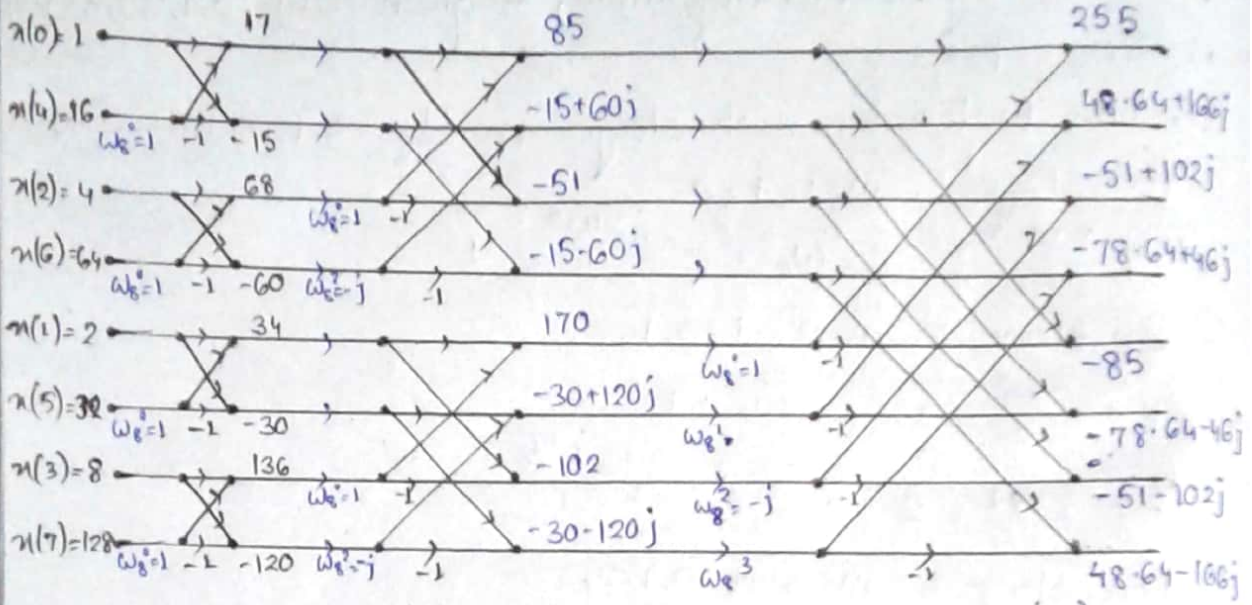
② Given $x(n) = 2^n$ & N=8, Find X(k) using DIT FFT Algorithm.

⇒ $x(n) = \{1, 2, 4, 8, 16, 32, 64, 128\}$



$(-30+120j)\left(\frac{1}{\sqrt{2}} - j\frac{1}{\sqrt{2}}\right)$

$= -15\sqrt{2} + 15\sqrt{2}j + 60\sqrt{2}j + 60\sqrt{2}$

$= 45\sqrt{2} + 75\sqrt{2}j$

$(-15+60j) + (45\sqrt{2} + 75\sqrt{2}j)$

$= 48.64 + 166j$

$(-15+60j) - (45\sqrt{2} + 75\sqrt{2}j)$

$= -78.64 - 46j$

$(-30-120j)\left(-\frac{1}{\sqrt{2}} - \frac{j}{\sqrt{2}}\right)$

$= \left(15\sqrt{2} + 60\sqrt{2}j + 15\sqrt{2}j - 60\sqrt{2}\right)$

$= (-45\sqrt{2} + 75\sqrt{2}j)$

$(-15-60j) + (-45\sqrt{2} + 75\sqrt{2}j)$

$= -78.64 + 46j$

$(-15-60j) - (-45\sqrt{2} + 75\sqrt{2}j)$

$= 48.64 - 166j$

$\therefore X(k) = \{255, 48.64+166j, -51+102j, -78.64+46j, -85, -78.64-46j, -51-102j, 48.64-166j\}$

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