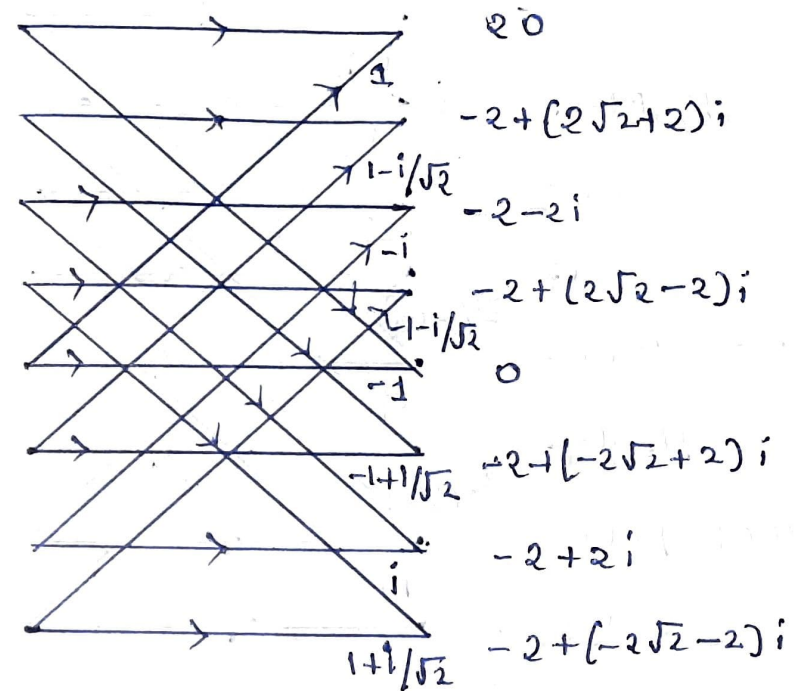
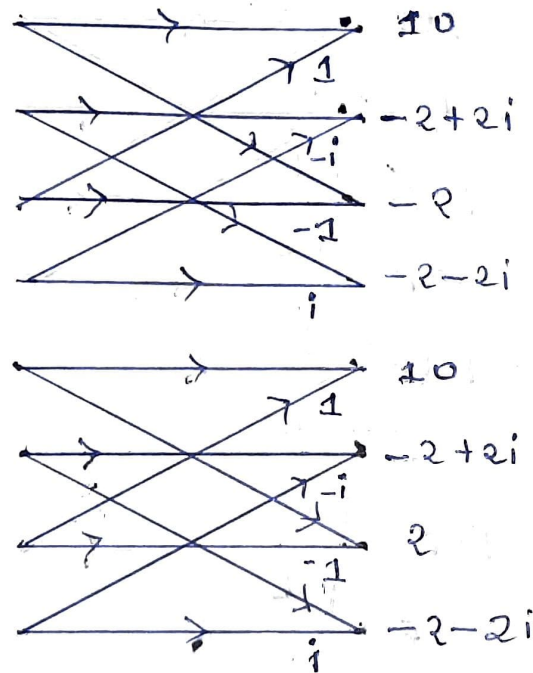
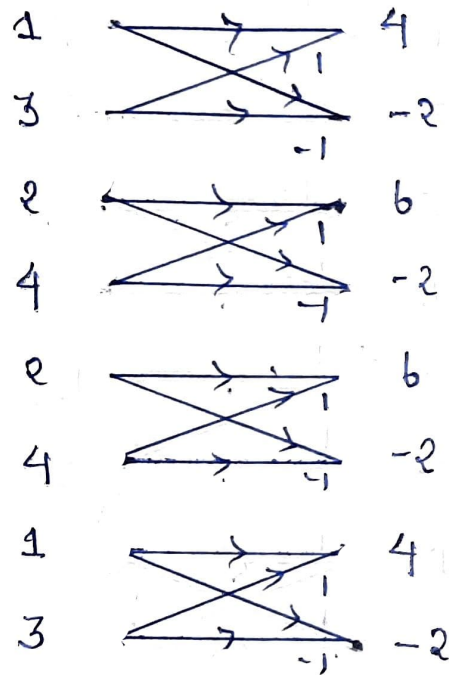


1. compute DFT using DIT-FFT

i)  $x(n) = \{1, 2, 2, 1, 3, 4, 4, 3\} \Rightarrow \{1, 2, 3, 4\} \{2, 1, 4, 3\} \Rightarrow \{1, 3\} \{2, 4\} \{2, 4\} \{1, 3\}$

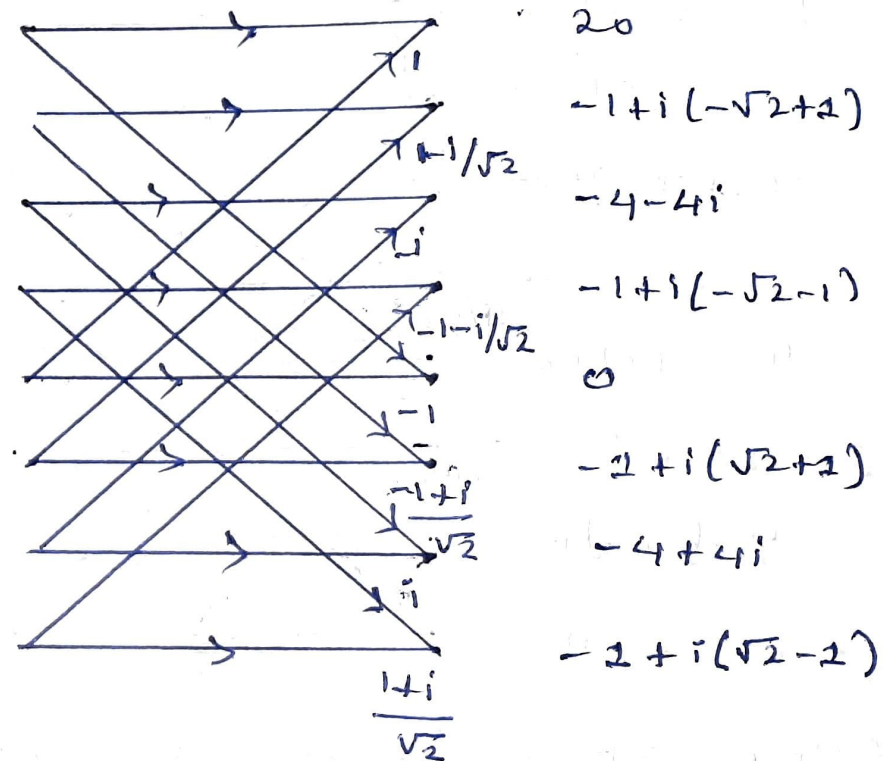
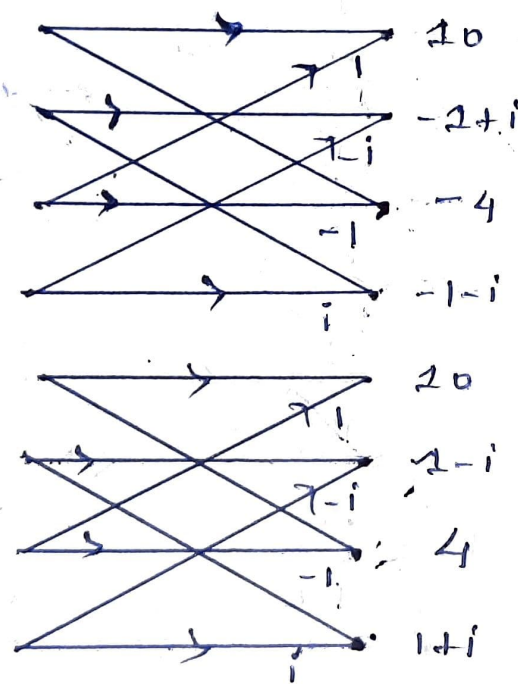
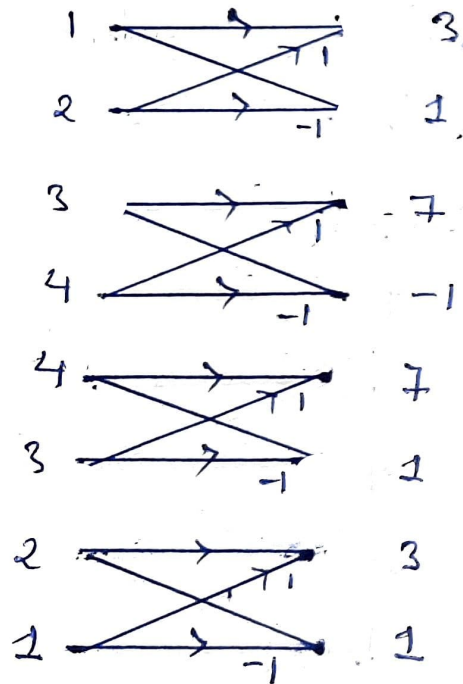


$$X(k) = \{20, -2 + (2\sqrt{2} + 2)i, -2 - 2i, -2 + (2\sqrt{2} - 2)i, 0, -2 + (-2\sqrt{2} + 2)i, -2 + 2i, -2 + (-2\sqrt{2} - 2)i\}$$

$$2) \quad x(n) = \{1, 4, 3, 2, 2, 3, 4, 1\}$$

$$\{1, 3, 2, 4\} \quad \{4, 2, 3, 1\}$$

$$\{1, 2\} \quad \{3, 4\} \quad \{4, 3\} \quad \{2, 1\}$$



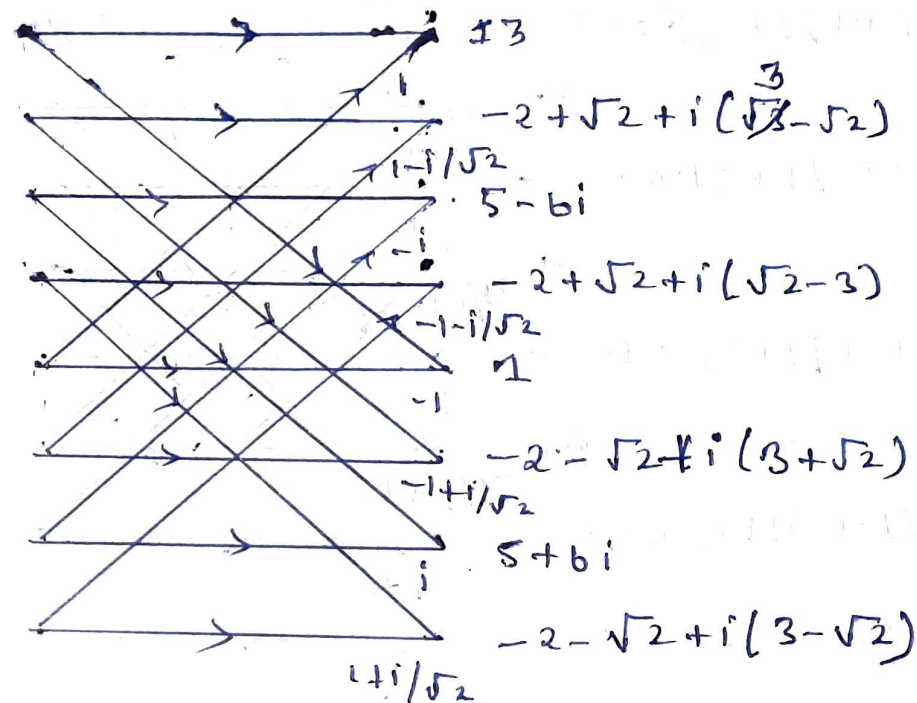
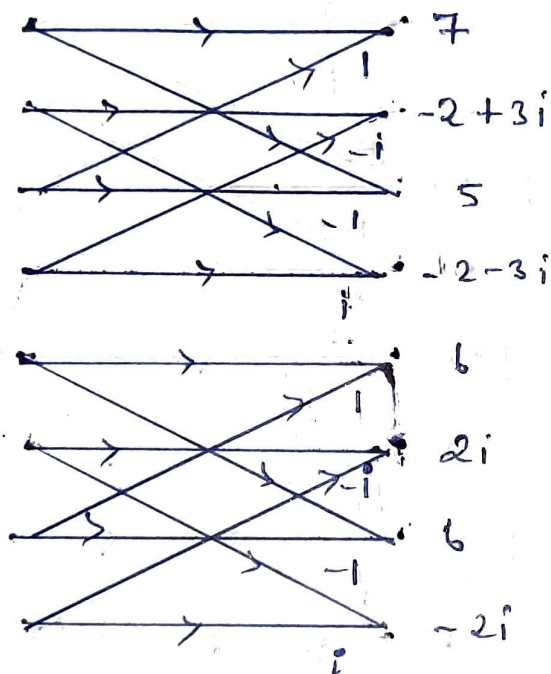
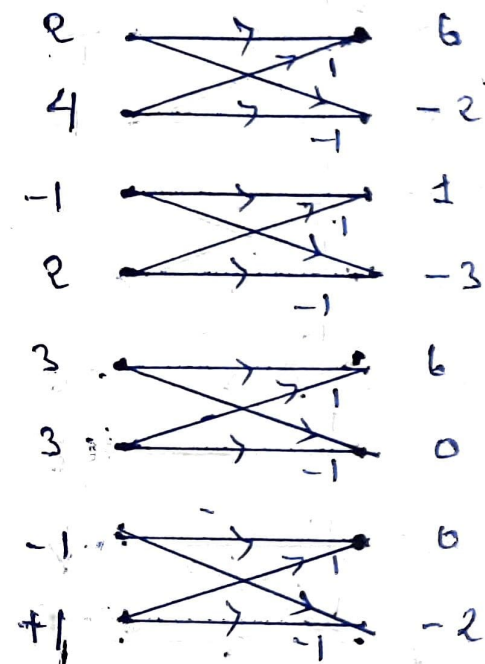
$$X(k) = \{20, -2 + i(-\sqrt{2} + 2), -4 - 4i, -1 + i(\sqrt{2} - 1), 0, -2 + i(\sqrt{2} + 2), -4 + 4i, -1 + i(\sqrt{2} - 1)\}$$

3)

$$x(n) = \{2, 3, -1, -1, 2, 3, 2, 1\}$$

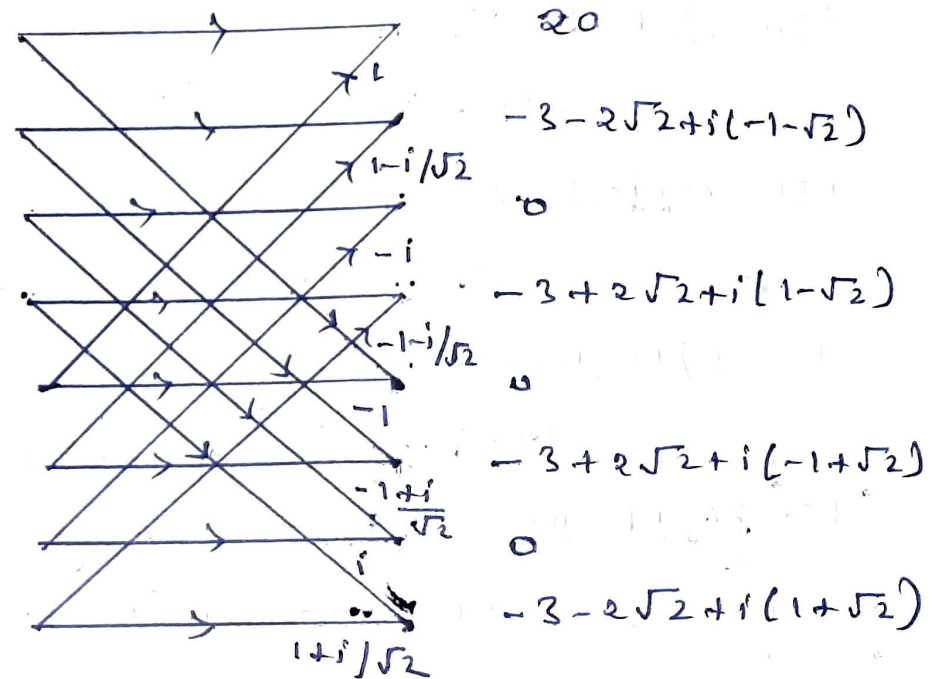
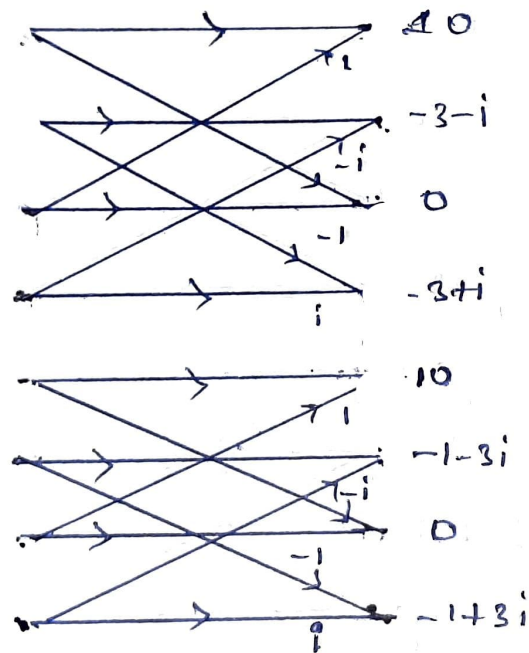
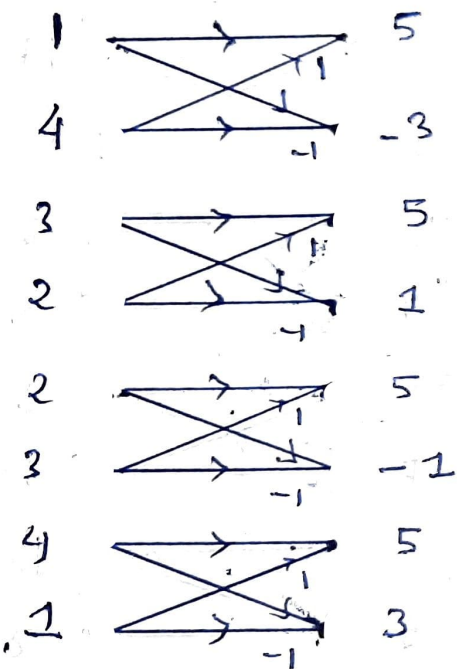
$$\{2, -1, 4, 2\} \quad \{3, -1, 3, 1\}$$

$$\{2, 4\} \quad \{-1, 2\} \quad \{3, 3\} \quad \{-1, 2\}$$



$$x(k) = \left\{ 13, -2 + \sqrt{2} + i(3 - \sqrt{2}), 5 - bi, -2 + \sqrt{2} + i(\sqrt{2} - 3), \right. \\ \left. 1, -2 - \sqrt{2} + i(3 + \sqrt{2}), 5 + bi, -2 - \sqrt{2} + i(3 - \sqrt{2}) \right\}$$

4)  $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$   
 $\{1, 3, 4, 2\} \{2, 4, 3, 1\}$   
 $\{1, 2, 4\} \{3, 2\} \{2, 3\} \{4, 4\}$



$$x(k) = \{20, -3-2\sqrt{2}+j(-1-\sqrt{2}), 0, -3+2\sqrt{2}+j(1-\sqrt{2}), 0, -3+2\sqrt{2}+j(-1+\sqrt{2}), 0, -3-2\sqrt{2}+j(1+\sqrt{2})\}$$

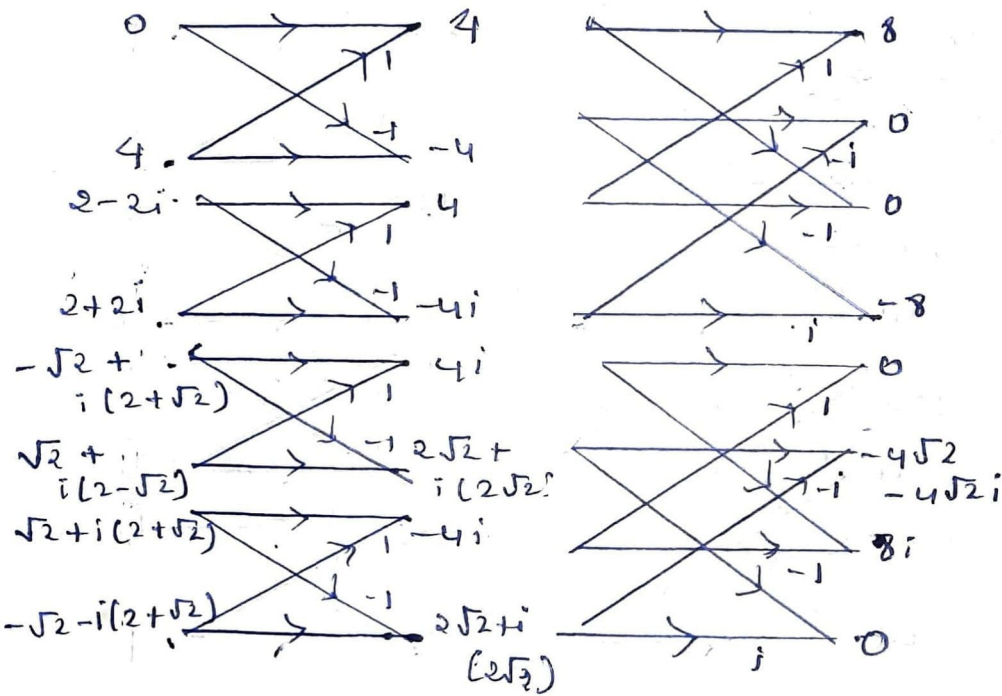


\* compute IDFT using DIT-FFT

$$1. x(k) = \{0, -\sqrt{2} + i(2+\sqrt{2}), 2-2i, \sqrt{2} + i(2+\sqrt{2}), 4, \sqrt{2} + i(2-\sqrt{2}), 2+i, -\sqrt{2} - i(2+\sqrt{2})\}$$

$$\{0, 2-2i, 4, 2+2i\} \quad \{ -\sqrt{2} + i(2+\sqrt{2}), \sqrt{2} + i(2+\sqrt{2}), \sqrt{2} + i(2-\sqrt{2}), -\sqrt{2} - i(2+\sqrt{2}) \}$$

$$\{0, 4\} \quad \{2-2i, 2+2i\} \quad \{ -\sqrt{2} + i(2+\sqrt{2}), \sqrt{2} + i(2-\sqrt{2}) \} \quad \{ \sqrt{2} + i(2+\sqrt{2}), -\sqrt{2} - i(2+\sqrt{2}) \}$$



$$x(n) = \{1, -i, -1, 1, 1, 1+i, 1, -1\}$$

calculations

$$-2\sqrt{2} + 2\sqrt{2}i$$

$$-2\sqrt{2} + 2\sqrt{2}$$

$$= 0$$

$$-4 - 4i - 4i - 4i^2$$

$$-4 - 4i(-1-i)$$

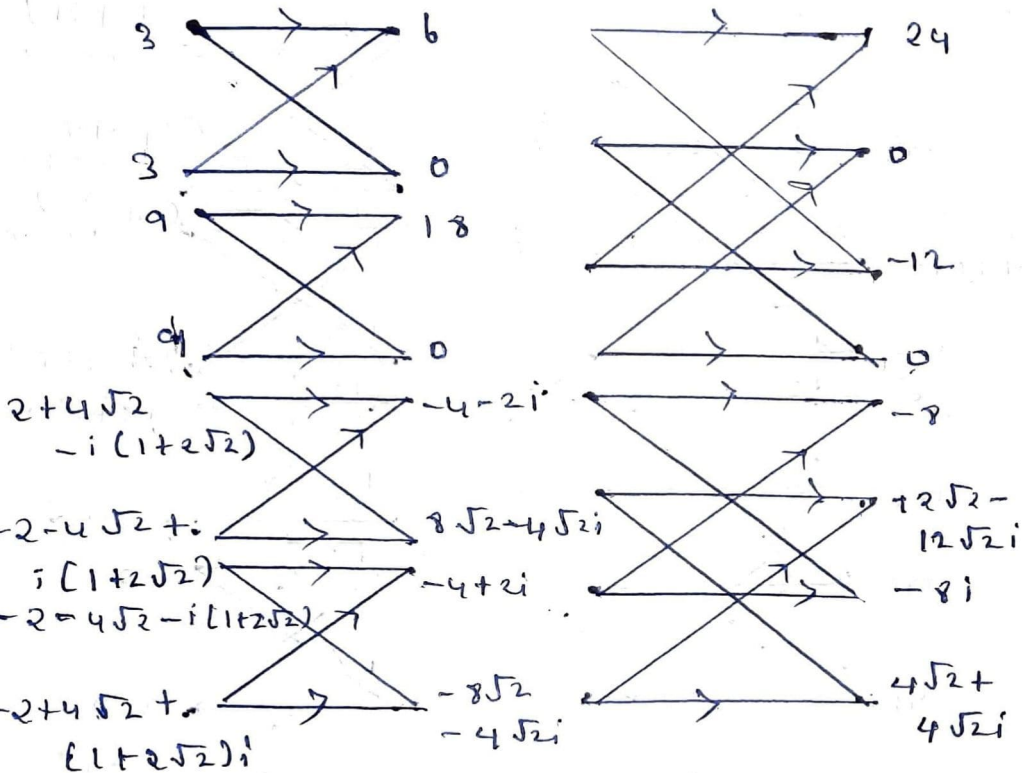
$$4 + 4i + 4i + 4$$

$$2. x(k) = \{3, -2+4\sqrt{2}-i(1+2\sqrt{2}), 9, -2-4\sqrt{2}-i(1+3\sqrt{2}), 3, -2-4\sqrt{2}+i(-1+2\sqrt{2}), 9, -2+4\sqrt{2}(1+2\sqrt{2})i\}$$

$$\{3, 9, 3, 9\} \quad \{-2+4\sqrt{2}-i(1+2\sqrt{2}), -2-4\sqrt{2}-i(1+2\sqrt{2}), -2-4\sqrt{2}+i(-1+2\sqrt{2}),$$

$$\{3, 3\} \quad \{9, 9\} \quad \{-2+4\sqrt{2}-i(1+2\sqrt{2}), -2-4\sqrt{2}+i(1+2\sqrt{2})\} \quad \{-2+4\sqrt{2}-i(1+2\sqrt{2}),$$

$$-2+4\sqrt{2}+i(1+2\sqrt{2})i\}$$



$$x(n) = \{2, 3, -1/2, -1, 4, -3, -5/2, 1\}$$

Calculations:

$$8\sqrt{2}-4\sqrt{2}i$$

$$= 8\sqrt{2}i+4\sqrt{2}$$

$$12\sqrt{2}-12\sqrt{2}i+8\sqrt{2}i$$

$$-4\sqrt{2}i = 4\sqrt{2}+4\sqrt{2}i$$

$$(4+4i)(-1+i)$$

$$= -4+4i-4i-4$$

$$= -8$$

$$(12-2i)(1-i)$$

$$= 12-12i-2i+2$$

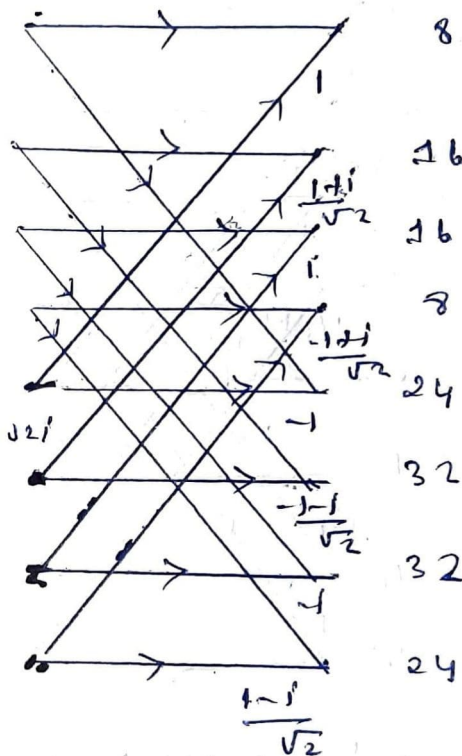
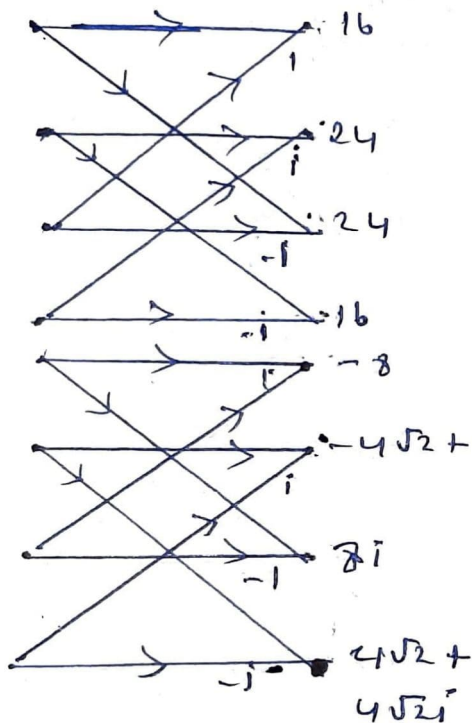
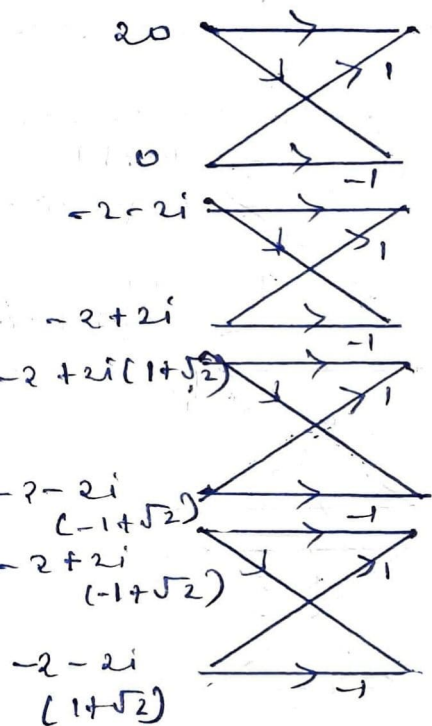
$$= -24$$

$$(4+4i)(1-i) = 4-4i+4i-4i^2 = 4-4i^2 = 4+4 = 8$$

$$3) \quad x(k) = \{20, -2+2i(1+\sqrt{2}), -2-2i, -2+2i(-1+\sqrt{2}), 0, -2-2i(-1+\sqrt{2}), -2+2i, -2-2i(1+\sqrt{2})\}$$

$$\{20, -2-2i, 0, -2+2i\} \quad \{-2+2i(1+\sqrt{2}), -2+2i(-1+\sqrt{2}), -2-2i(-1+\sqrt{2}), -2-2i(1+\sqrt{2})\}$$

$$\{20, 0\} \quad \{-2-2i, -2+2i\} \quad \{-2+2i(1+\sqrt{2}), -2-2i(-1+\sqrt{2})\} \quad \{-2+2i(-1+\sqrt{2}), -2-2i(1+\sqrt{2})\}$$



calculations

$$\begin{aligned} & (-4+4i)(1+i) \\ & -4-4i+4i+4i^2 \\ & (-4+4i)(-1+i) \\ & -4+4i-4i+4i^2 \\ & (-4+4i)(-1-i) \\ & 4+4i-4i-4i^2 \\ & (4+4i)(1-i) \\ & 4-4i+4i-4 \end{aligned}$$

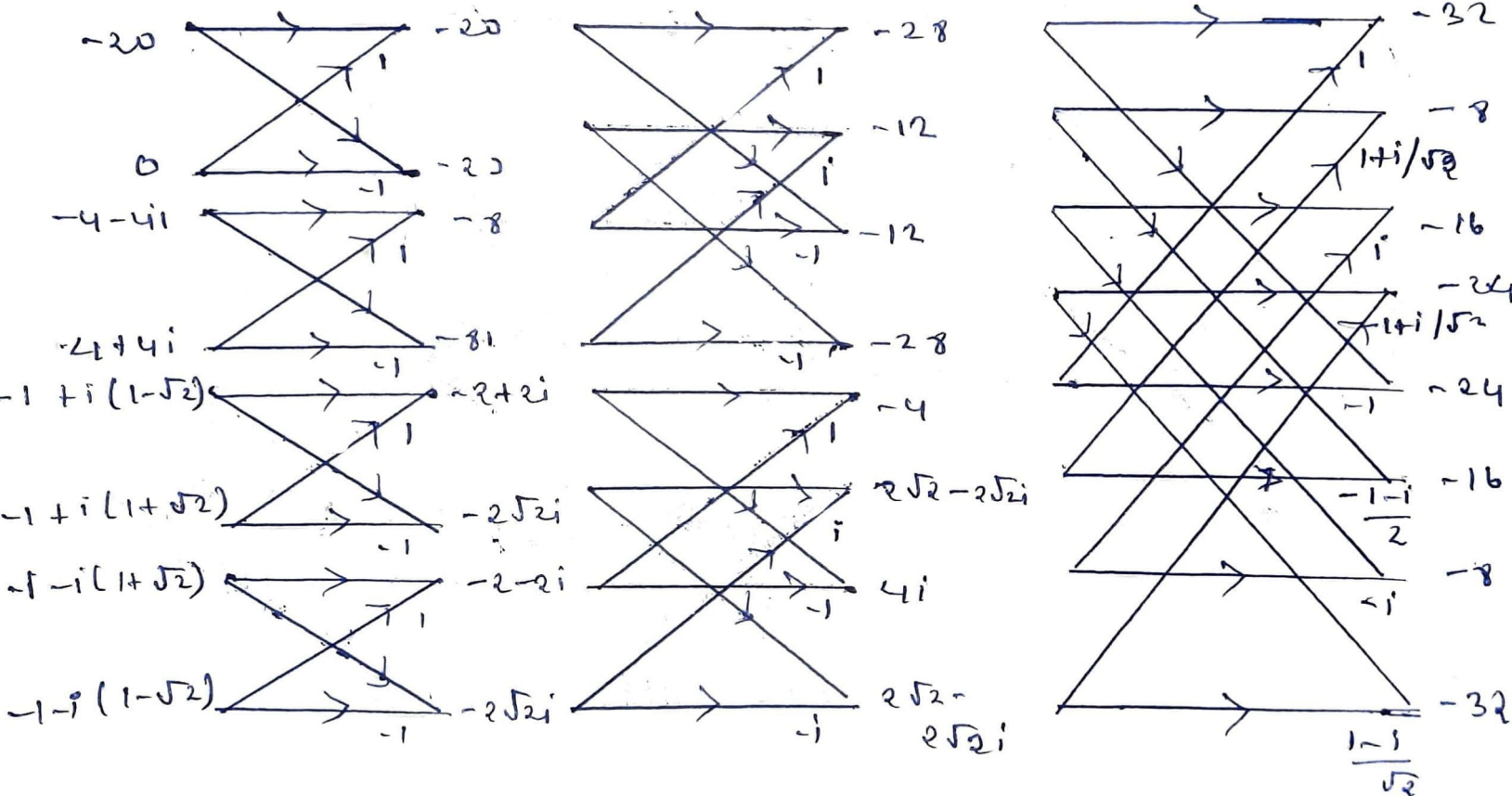
$$x(n) = \{1, 2, 2, 1, 3, 4, 4, 3\}$$



$$4) \quad x(k) = \{-20, -1+i(1-\sqrt{2}), -4-4i, -1-i(1+\sqrt{2}), 0, -1+i(1+\sqrt{2}), -4+4i, -1-i(1-\sqrt{2})\}$$

$$\{-20, -4-4i, 0, 4+4i\} \quad \{-1+i(1-\sqrt{2}), -1-i(1+\sqrt{2}), -1+i(1+\sqrt{2}), -1-i(1-\sqrt{2})\}$$

$$\{-20, 0\} \quad \{-4-4i, 4+4i\} \quad \{-1+i(1-\sqrt{2})\} \quad -1+i(1+\sqrt{2}) \quad \{-1-i(1+\sqrt{2}), -1-i(1-\sqrt{2})\}$$



$$n(n) = \{-4, -1, -2, -3, -3, -2, -1, -4\}$$

calculations

$$(2-2i)(1+i)$$

$$2+2i-2i-2i^2$$

$$(-2-2i)(-1+i)$$

$$2-2i+2i-2i^2$$

$$(2-2i)(-1-i)$$

$$-2-2i+2i^2+2i$$

$$(-2-2i)(1-i)$$

$$-2+2i-2i+2i^2$$