Q9. Fast Fourier Transform (Dr. Meyer-Baese)

For a prime factor FFT the following 2D DFT is used:

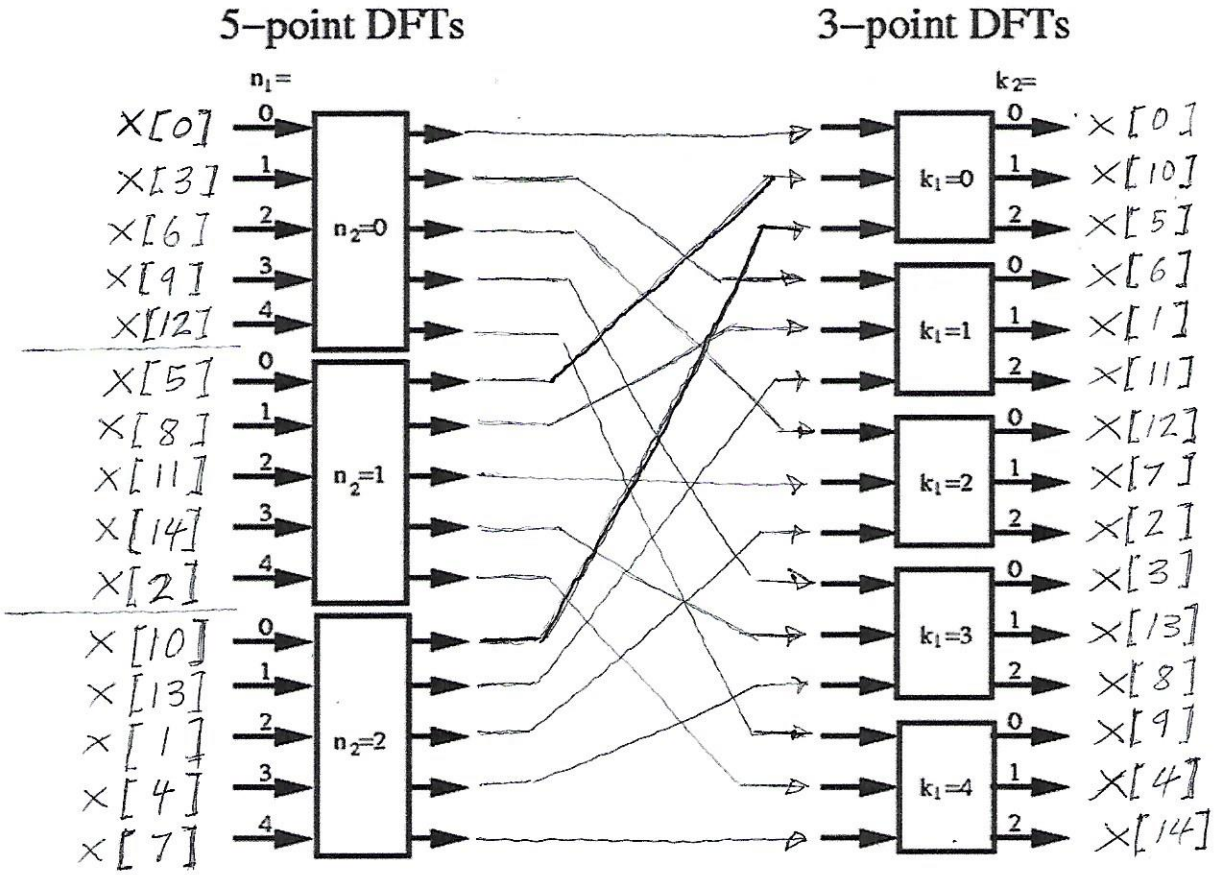
$$X[k_1, k_2] = \sum_{n_2=0}^{N_2-1} W_{N_2}^{n_2 k_2} \sum_{n_1=0}^{N_1-1} x[n_1, n_2] W_{N_1}^{n_1 k_1} \quad !$$

1. Complete the following table for the index map for a $N = 15$ with $N_1 = 5$ and $N_2 = 3$ FFT with: $n = 3n_1 + 5n_2$ mod 15 and $k = 6k_1 + 10k_2$ mod 15. (40 points)

n_2	n_1				
	0	1	2	3	4
0	0	3	6	9	12
1	5	8	11	14	2
2	10	13	1	4	7

k_2	k_1				
	0	1	2	3	4
0	0	6	12	3	9
1	10	1	7	13	4
2	5	11	2	8	14

2. Complete the SFG (for x[n], X [k] and connection between first and second stage) for the FFT: (60 points)



$$W = W_{N_2}^{n_2 k_2} = W_3^{n_2 k_2}$$