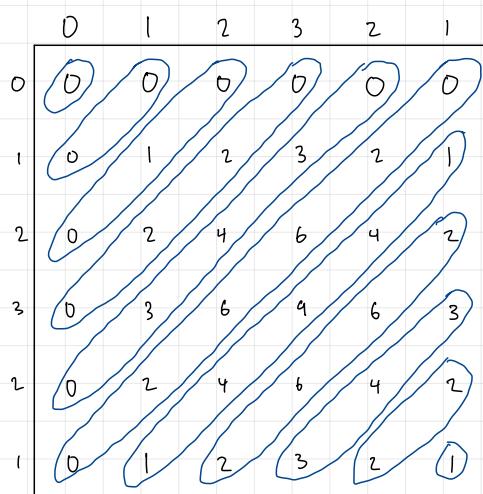
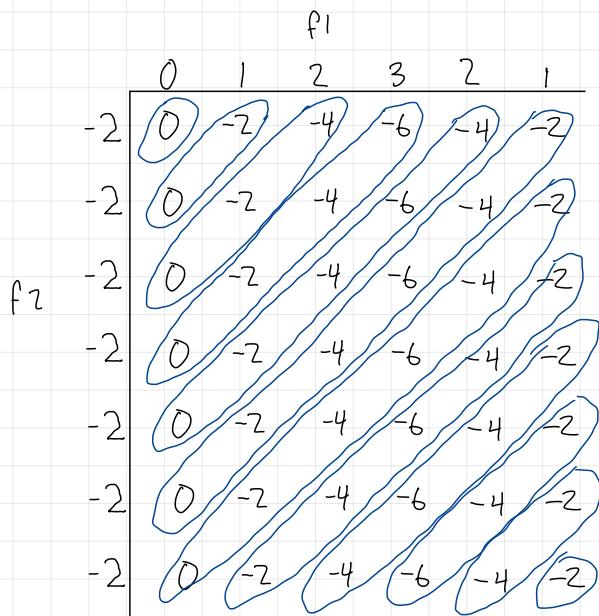


$$2.A.) f_1 * f_1 = 0, 0, 1, 4, 10, 16, 19, 16, 10, 4, 1$$



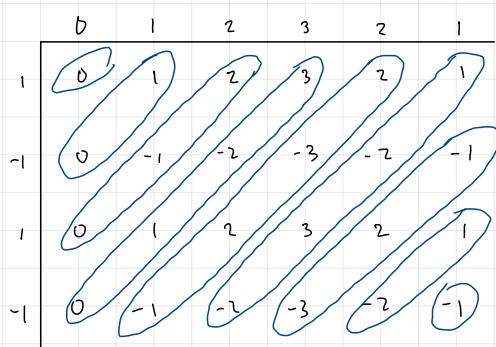
m	y[m]	
0	0	= 0
1	0+0	= 0
2	0+1+0	= 1
3	0+2+2+0	= 4
4	0+3+4+3+0	= 10
5	0+2+6+6+2+0	= 16
6	1+4+9+4+1	= 19
7	2+6+6+2	= 16
8	3+4+3	= 10
9	2+2	= 4
10	1	= 1

$$2.B.) f_1 * f_2 = 0, -2, -6, -12, -16, -18, -18, -16, -12, -6, -2$$



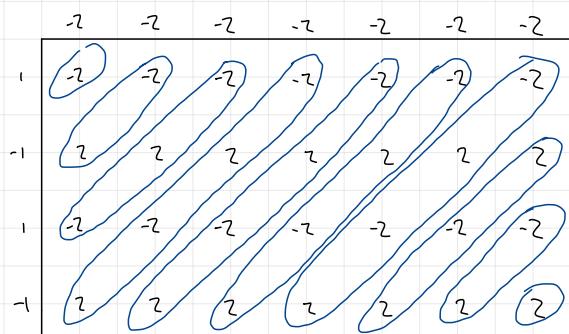
m	y[m]	
0	0	= 0
1	0-2	= -2
2	0-2-4	= -6
3	0-2-4-6	= -12
4	0-2-4-6-4	= -16
5	0-2-4-6-4-2	= -18
6	0-2-4-6-4-2	= -18
7	-2-4-6-4-2	= -18
8	-4-6-4-2	= -16
9	-6-4-2	= -12
10	-4-2	= -6
11	-2	= -2

$$2.C.) f_1 * f_3 = 0, 1, 1, 2, 0, 0, -2, -1, -1$$



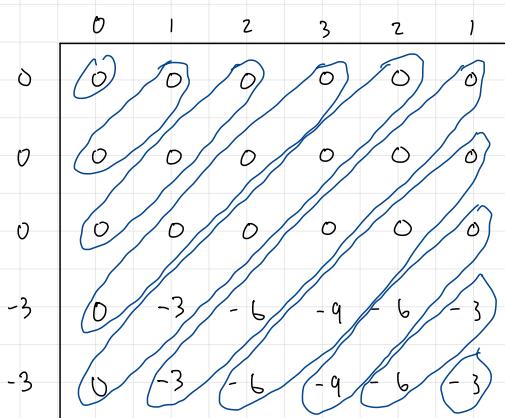
K	y[k]	
0	0	= 0
1	0+1	= 1
2	0-1+2	= 1
3	0+1-2+3	= 2
4	-1+2-3+2	= 0
5	-2+3-2+1	= 0
6	-3+2-1	= -2
7	-2+1	= -1
8	-1	= -1

$$2.D.) f_2 * f_3 = -2, 0, -2, 0, 0, 0, 0, 0, 2, 0, 2$$



k	$y[k]$	$=$	
0	-2	\approx	-2
1	$2 - 2$	\approx	0
2	$-2 + 2 - 2$	$=$	-2
3	$2 - 2 + 2 - 2$	$=$	0
4	$2 - 2 + 2 - 2$	$=$	0
5	$2 - 2 + 2 - 2$	$=$	0
6	$2 - 2 + 2 - 2$	$=$	0
7	$2 - 2 + 2$	$=$	2
8	$2 - 2$	$=$	0
9	2	$=$	2

$$2. E) \quad f_1 * f_4 = 0, 0, 0, 0, -3, -9, -15, -15, -9, -3$$



k	$y[k]$	
0	0	$= 0$
1	$0 + 0$	$= 0$
2	$0 + 0 + 0$	$= 0$
3	$0 + 0 + 0 + 0$	$= 0$
4	$0 - 3 + 0 + 0 + 0$	$= -3$
5	$-3 - 6 + 0 + 0 + 0$	$= -9$
6	$-6 - 9 + 0 + 0$	$= -15$
7	$-9 - 6 + 0$	$= -15$
8	$-6 - 3$	$= -9$
9	-3	$= -3$

$$(D^3 + 5D^2 + 12D + 15) y(t) = (D + 1.5) f(t)$$

$$H(s) = \frac{y(t)}{f(t)} = \frac{D + 1.5}{D^3 + 5D^2 + 12D + 15}$$

$$\mathcal{L}^{-1}[H(s)] = h(t)$$

$$h(t) = -0.175 e^{-2.604t} + 2[0.201 e^{-1.198t} \cos(-2.08t + 1.12)]$$

$$\text{zero state} = h(t) * \sin(2.5\pi t) = \frac{s + 1.5}{s^3 + 5s^2 + 12s + 15} \cdot \frac{2.5\pi}{s^2 + (2.5\pi)^2}$$

$$= \mathcal{L}^{-1} \left[\frac{s + 1.5}{s^3 + 5s^2 + 12s + 15} \cdot \frac{2.5\pi}{s^2 + (2.5\pi)^2} \right] = \mathcal{L}^{-1} \left[\frac{7.85s + 11.78}{s^5 + 5s^4 + 73.69s^3 + 323.45s^2 + 740.28s + 925.35} \right]$$

$$\text{zero state} = -0.02 e^{-2.604t} + 2[0.027 e^{-1.198t} \cos(-2.08t - 1.036)] + 2[0.008 \cos(7.85t + 7.03)]$$

$$\text{zero input} = 0.05 e^{-2.604t} + 2[0.98 e^{-1.198t} \cos(2.08t - 3.01)]$$

total response = zero state + zero input

$$= -0.02 e^{-2.604t} + 2[0.027 e^{-1.198t} \cos(-2.08t - 1.036)] + 2[0.008 \cos(7.85t + 7.03)] + \\ + 0.05 e^{-2.604t} + 2[0.98 e^{-1.198t} \cos(2.08t - 3.01)]$$