

2.A.)  $f1 * f1 = 0, 0, 1, 4, 10, 16, 19, 16, 10, 4, 1$

	0	1	2	3	2	1
0	0	0	0	0	0	0
1	0	1	2	3	2	1
2	0	2	4	6	4	2
3	0	3	6	9	6	3
2	0	2	4	6	4	2
1	0	1	2	3	2	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.)  $f1 * f2 = 0, -2, -6, -12, -16, -18, -18, -16, -12, -6, -2$

	0	1	2	3	2	1
-2	0	-2	-4	-6	-4	-2
-2	0	-2	-4	-6	-4	-2
-2	0	-2	-4	-6	-4	-2
-2	0	-2	-4	-6	-4	-2
-2	0	-2	-4	-6	-4	-2
-2	0	-2	-4	-6	-4	-2
-2	0	-2	-4	-6	-4	-2

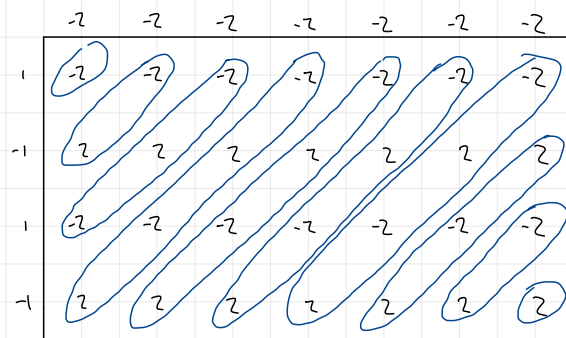
m	y[m]	
0	0	= 0
1	0-2	= -2
2	0-2-4	= -6
3	0-2-4-6	= -12
4	0-2-4-6-4	= -16
5	0-2-4-6-4-2	= -18
6	0-2-4-6-4-2	= -18
7	-2-4-6-4-2	= -18
8	-4-6-4-2	= -16
9	-6-4-2	= -12
10	-4-2	= -6
11	-2	= -2

2.C.)  $f1 * f3 = 0, 1, 1, 2, 0, 0, -2, -1, -1$

	0	1	2	3	2	1
1	0	1	2	3	2	1
-1	0	-1	-2	-3	-2	-1
1	0	1	2	3	2	1
-1	0	-1	-2	-3	-2	-1

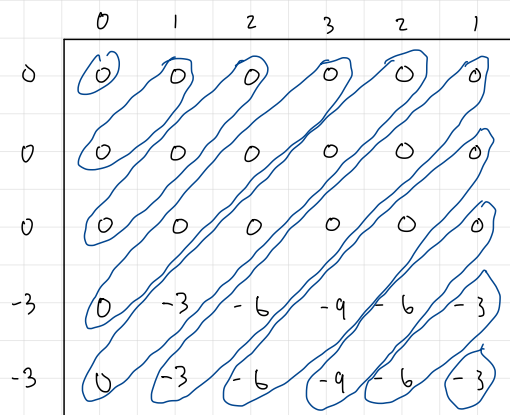
k	y[k]	
0	0	= 0
1	0+1	= 1
2	0-1+2	= 1
3	0+1-2+3	= 2
4	-1+2-3+2	= 0
5	-2+3-2+1	= 0
6	-3+2-1	= -2
7	-2+1	= -1
8	-1	= -1

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



k	y[k]	
0	-2	= -2
1	2-2	= 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.)  $f_1 * f_4 = 0, 0, 0, 0, -3, -9, -15, -15, -9, -3$



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

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

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

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

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

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

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

$$\text{zero state} = -0.02e^{-2.604t} + 2[0.027e^{-1.19t} \cos(-2.08t - 1.036)] + 2[0.008 \cos(7.85t + 2.03)]$$

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

$$\text{total response} = \text{zero state} + \text{zero input}$$

$$= -0.02e^{-2.604t} + 2[0.027e^{-1.19t} \cos(-2.08t - 1.036)] + 2[0.008 \cos(7.85t + 2.03)] + 0.05e^{-2.604t} + 2[0.98e^{-1.198t} \cos(2.08t - 3.01)]$$