CS118 HW1 Solution

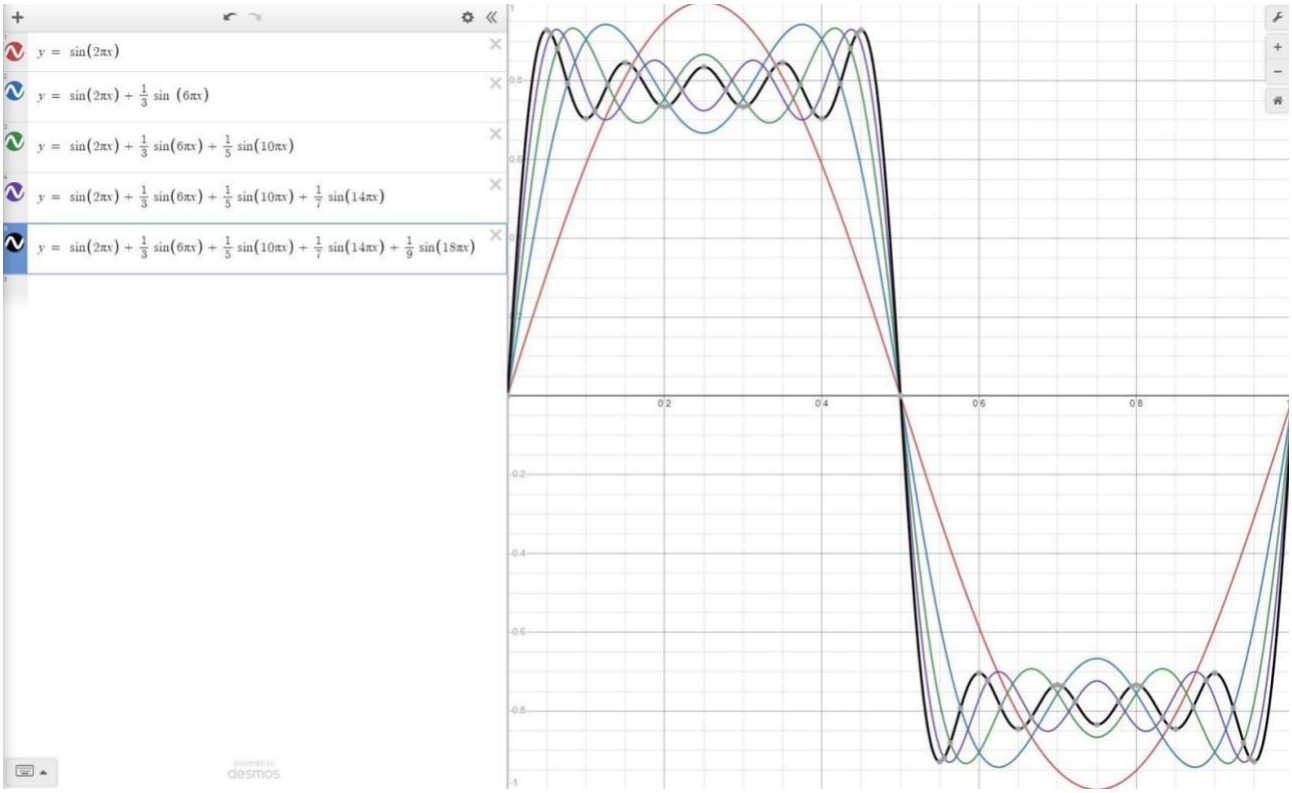
Fall 22

Q1:

A. Recall that $\int sin(nx)dx = -\frac{\cos(nx)}{n}$, So, the nth coefficient b_n with period of T is $b_n = \int_0^T f(t)\sin(2\pi nt)\,dt = \frac{1}{2n} - \frac{\cos(n\pi)}{2n}$. The integral result in the scaling factor being inversely proportional to n is due to the n is in the divider resulting from integration $sin(nx)$.

B.

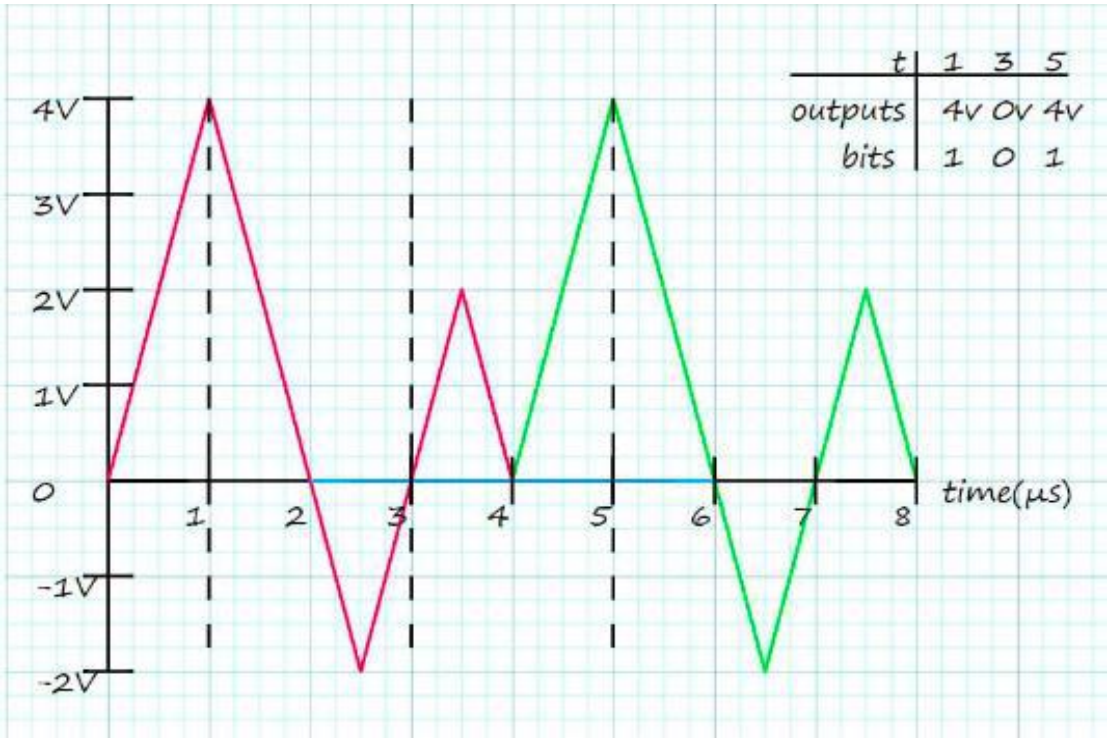
1. Shown below



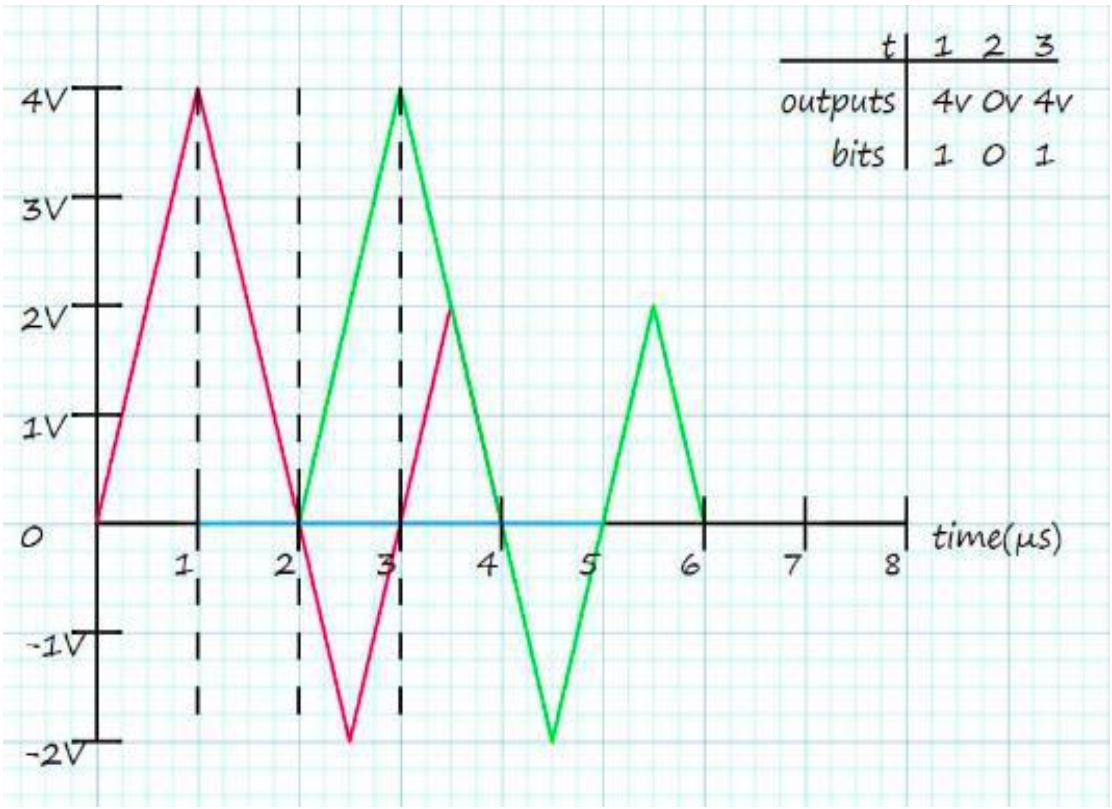
2. The bandwidth should be 1, 3, 5, 7, 9hz respectively.
3. The formula of percent error is $Math.abs(\frac{Actural-Exp}{Exp})$, So there are 2 set of solution,
   Assume 1 as amplitude: 41.22%, 33.33%, 30.72%, 29.96%, 29.64%
   Assume $\frac{\pi}{4}$ as amplitude: 27.31%, 20.04%, 15.20%, 10.83%, 10.41%
4. 0.178, 0.087, 0.0674, 0.0051, 0.041

Q2:

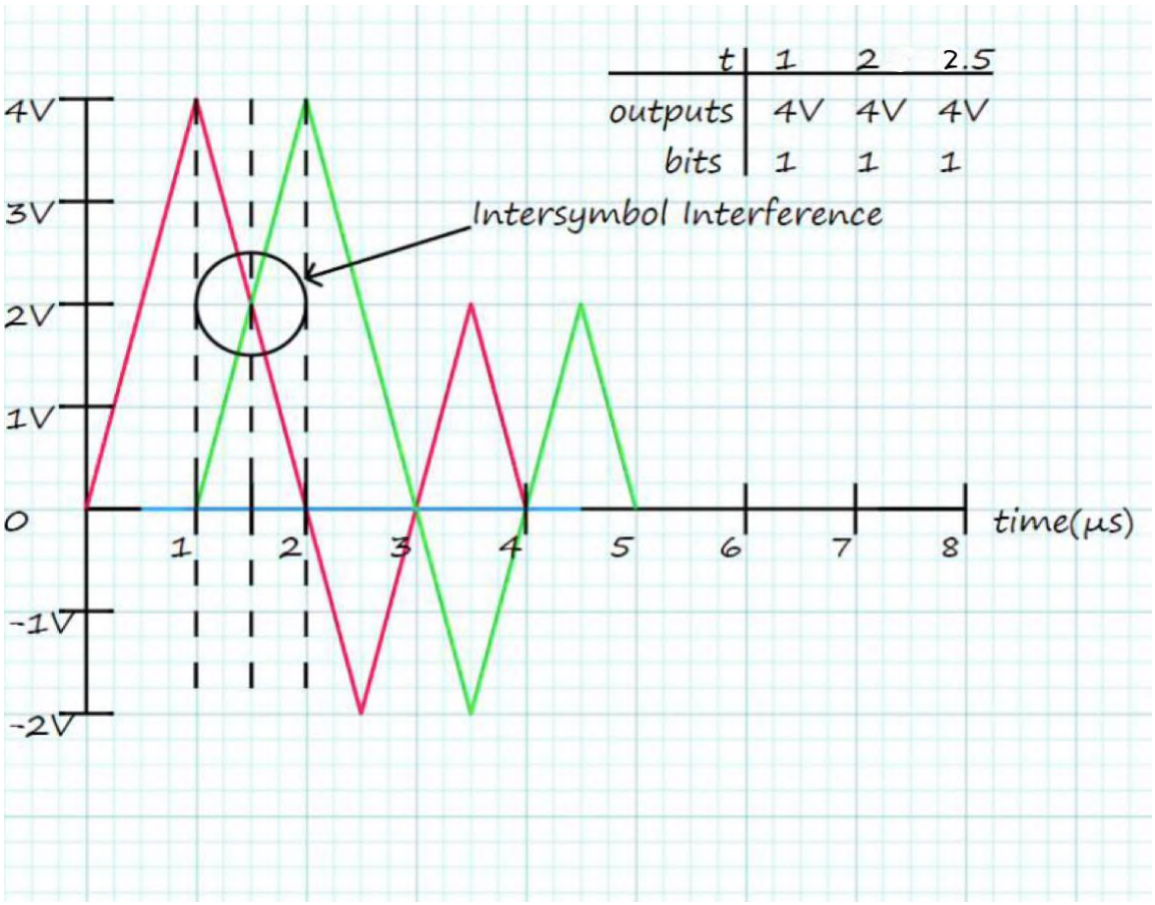
1)


t 1 3 5
outputs 4v 0v 4v
bits 1 0 1
4V
3V
2V
1V
0
-1V
-2V
1
2
3
4
5
6
7
8
time(μs)

2)

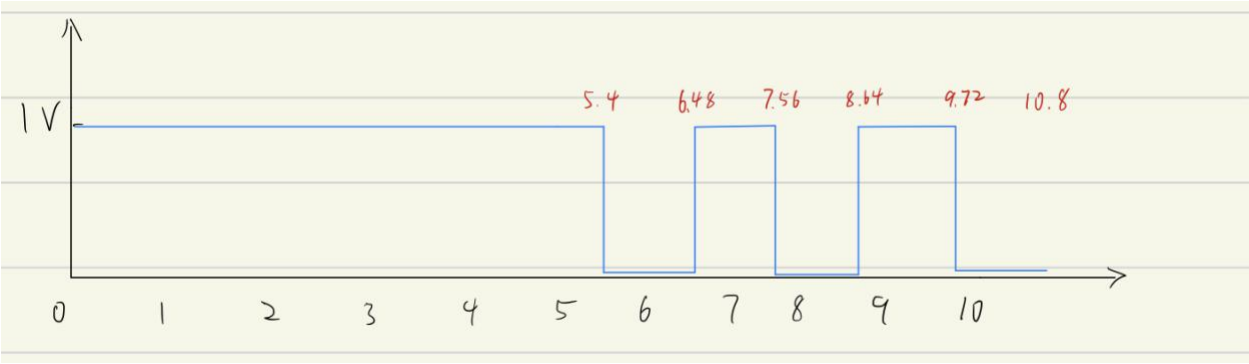

t 1 2 3
outputs 4v 0v 4v
bits 1 0 1
4V
3V
2V
1V
0
-1V
-2V
1
2
3
4
5
6
7
8
time(μs)

3)

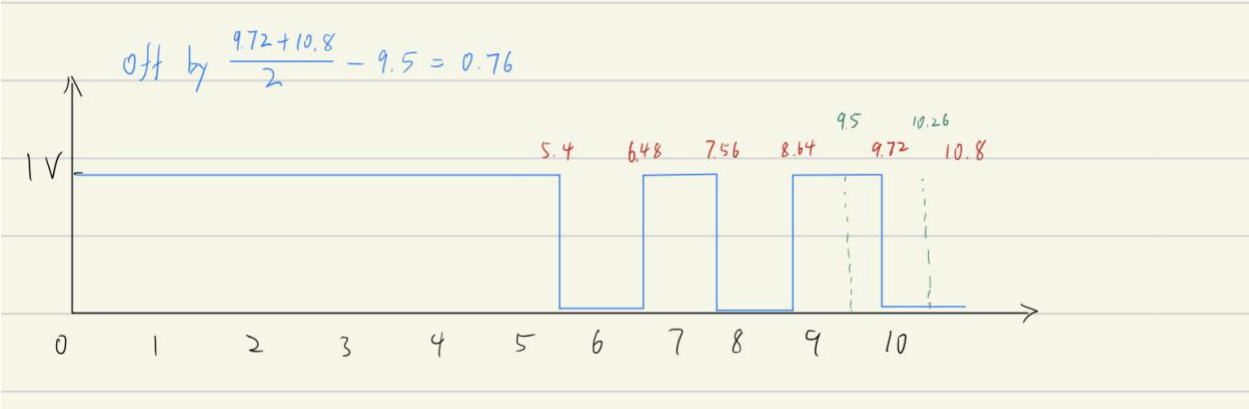

t 1 2 2.5
outputs 4V 4V 4V
bits 1 1 1
Intersymbol Interference
4V
3V
2V
1V
0
-1V
-2V
1 2 3 4 5 6 7 8
time(μs)

Q3:

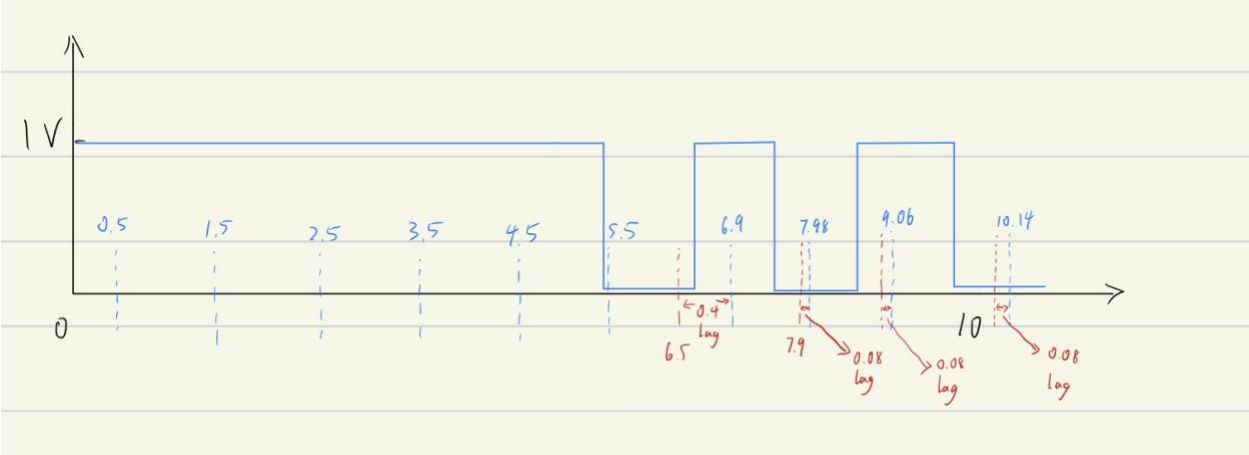
1.


1V
5.4
6.48
7.56
8.64
9.72
10.8
0 1 2 3 4 5 6 7 8 9 10

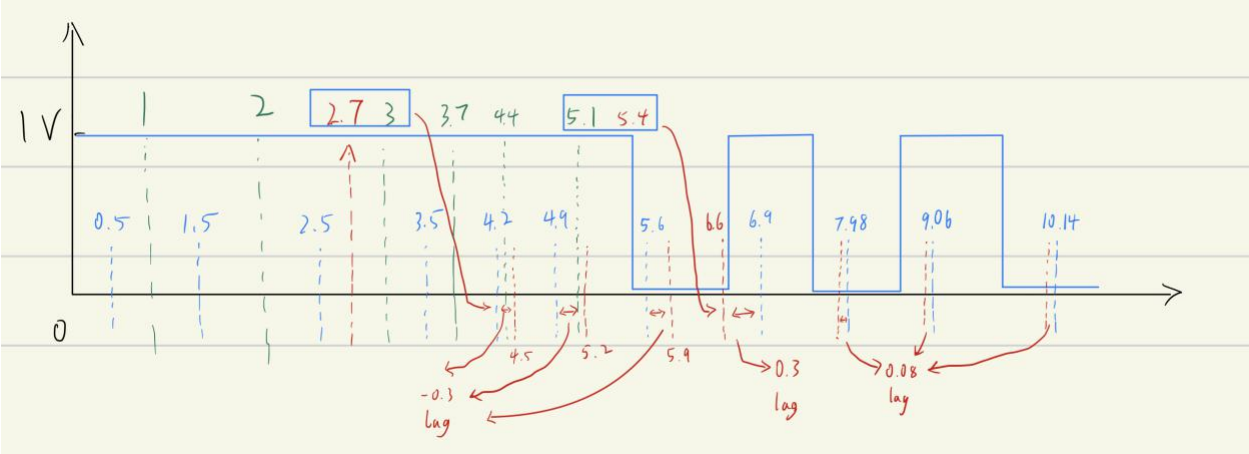
2. Or simply 0.08 * 10 = 0.8



3.



t	lag	P	P = P +T + lag	T+lag	A	A-P
0.5	0	0	1	1	X	X
1.5	0	1	2	1	X	X
2.5	0	2	3	1	X	X
3.5	0	3	4	1	X	X
4.5	0.4	4	5	1	5.4	0.4
5.5	0.08	5	6.4	1.4	6.48	0.08
6.9	0.08	6.4	7.48	1.08	7.56	0.08
7.98	0.08	7.48	8.56	1.08	8.64	0.08
9.06	0.08	8.56	9.64	1.08	9.72	0.08
10.14	0.08	9.64	10.72	1.08	X	X

4. No effect, since it occurs before sync code begins(0.5).
5. 

It sampled one extra bit, which lead to 1 1 1 1 1 1 0 1 0 1 0

t	lag	P	P = P +T + lag	T+lag	A	A-P
0.5	0	0	1	1	X	X
1.5	0	1	2	1	X	X
2.5	0	2	3	1	2.7	-0.3
3.5	-0.3	3	3.7	0.7	X	X
4.2	-0.3	3.7	4.4	0.7	X	X
4.9	-0.3	4.4	5.1	0.7	5.4	0.3
5.6	0.3	5.1	6.4	1.3	6.48	0.08
6.9	0.08	6.4	7.48	1.08	7.56	0.08
7.98	0.08	7.48	8.56	1.08	8.64	0.08
9.06	0.08	8.56	9.64	1.08	9.72	0.08
10.14	0.08	9.64	10.72	1.08	X	X