CMSC 465 Homework 3

Part a:

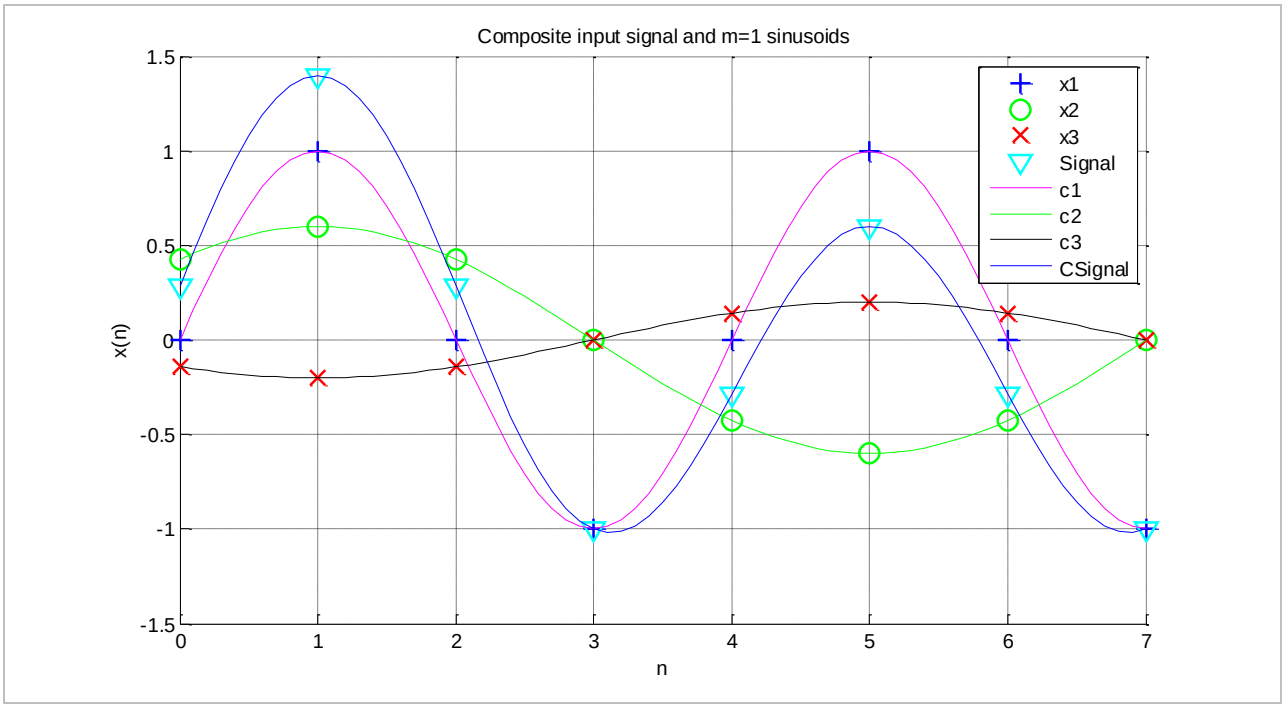

Figure 1. Plot of an input signal and its three component signals.

Part b:

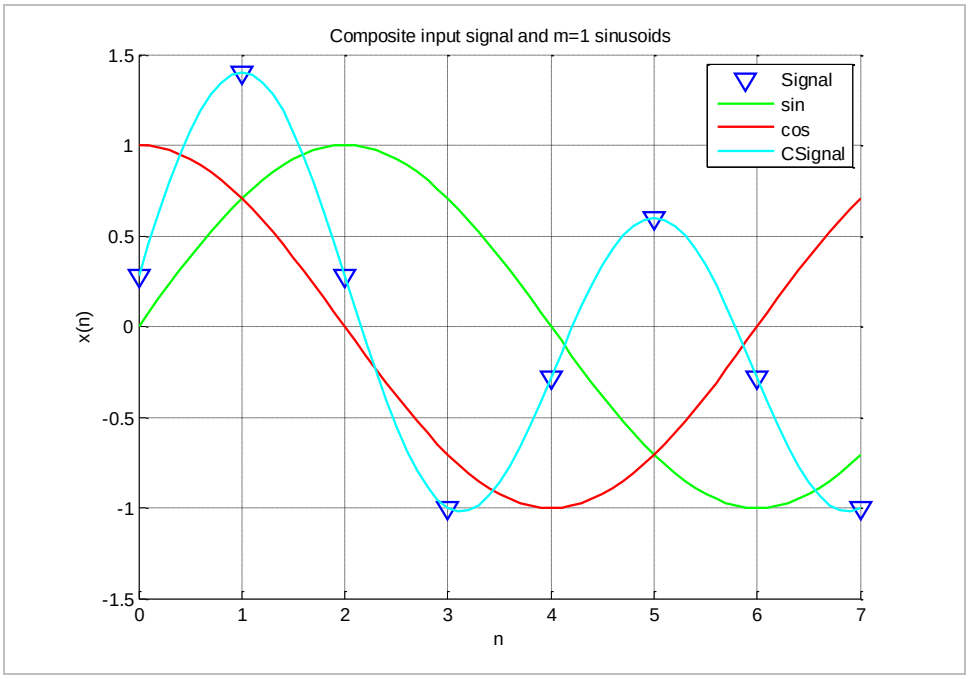

Figure 2. Plot of composite signal with 1kHz sinusoids for *m*=1.

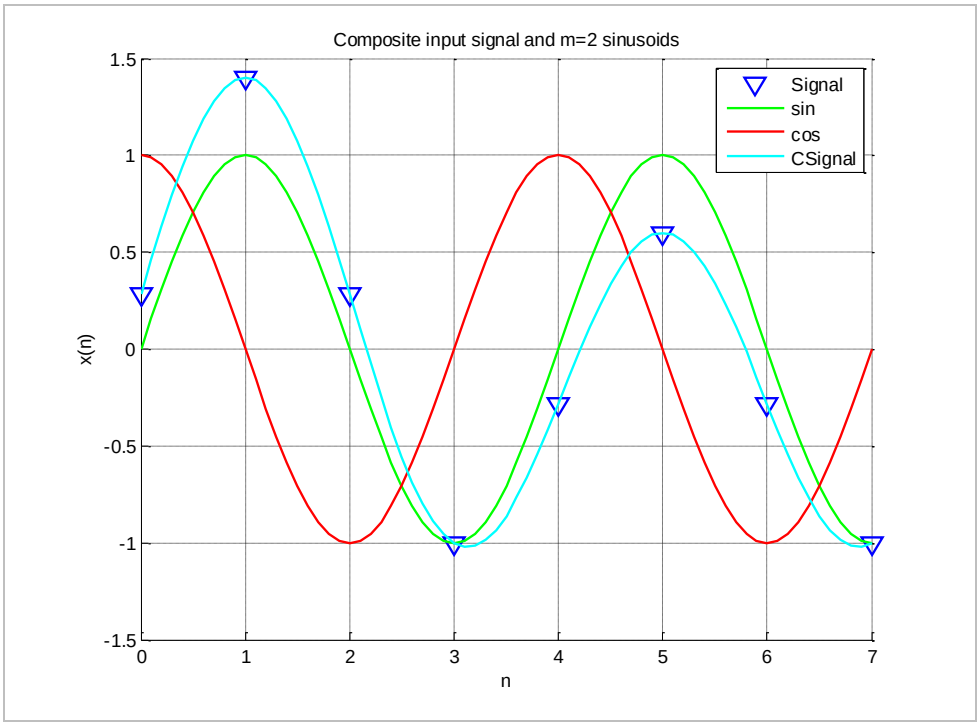

Figure 3. Plot of composite signal with 1kHz sinusoids for *m*=2.

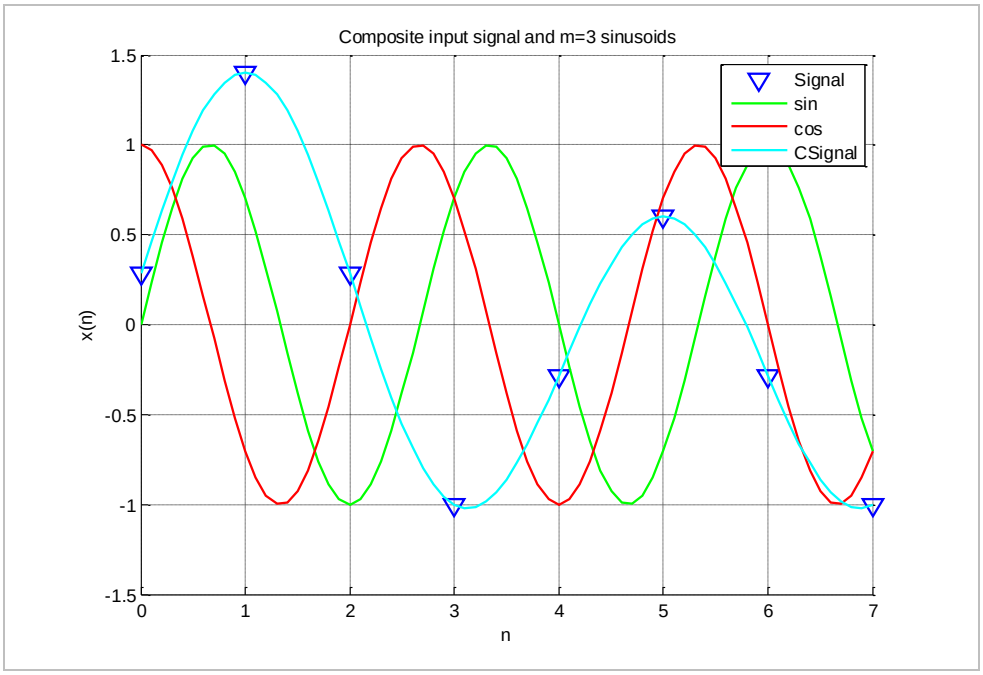

Figure 4. Plot of composite signal with 1kHz sinusoids for *m*=3.

Part c:

m	Magnitude	Phase (degrees)
0	0.0000	0
1.0000	1.6000	-45.0000
2.0000	4.0000	-90.0000
3.0000	0.0000	-165.9638
4.0000	0.0000	90.0000
5.0000	0.0000	63.4349
6.0000	4.0000	90.0000
7.0000	1.6000	45.0000

Figure 5. Console output of the DFT on x(t).

	m	Magnitude	Phase (degrees)
1	0	2.2204e-...	0
2	1	1.6000	-45.0000
3	2	4	-90
4	3	9.1551e-...	-165.9638
5	4	4.0870e-...	90
6	5	9.9301e-...	63.4349
7	6	4.0000	90.0000
8	7	1.6000	45.0000

Figure 6. Table output of the DFT on x(t). Although the same data were used for this table and the output shown in Figure 5, the magnitude output is significantly different.

Part d:

m	Magnitude	Phase (degrees)
0	0.0000	0
1.0000	1.6000	-135.0000
2.0000	4.0000	90.0000
3.0000	0.0000	-15.6422
4.0000	0.0000	-90.0000
5.0000	0.0000	11.8887
6.0000	4.0000	-90.0000
7.0000	1.6000	135.0000

Figure7. Console output of the DFT on the shifted input signal

	m	Magnitude	Phase (degrees)
1	0	2.2204e-...	0
2	1	1.6000	-135.0000
3	2	4	90.0000
4	3	1.4412e-...	-15.6422
5	4	2.9392e-...	-90
6	5	1.0778e-...	11.8887
7	6	4	-90.0000
8	7	1.6000	135.0000

Figure 8. Table output of the DFT on the shifted input signal. Although the same data were used for this table and the output shown in Figure 7, the magnitude output is significantly different.

Despite my best efforts, I was unable obtain the correct phase figures here and in Part c. However, I can state that it makes sense the magnitude remains unchanged in Figures 5 and 7 as the input signal did not change but was shifted so that later samples occur earlier in time. Had my phase numbers been correct, they should have indicated that each of the DFT's complex terms were shifted by $360km/N$ degrees where k represents the number of shifts. Figure 9 is an attempt at analyzing this.

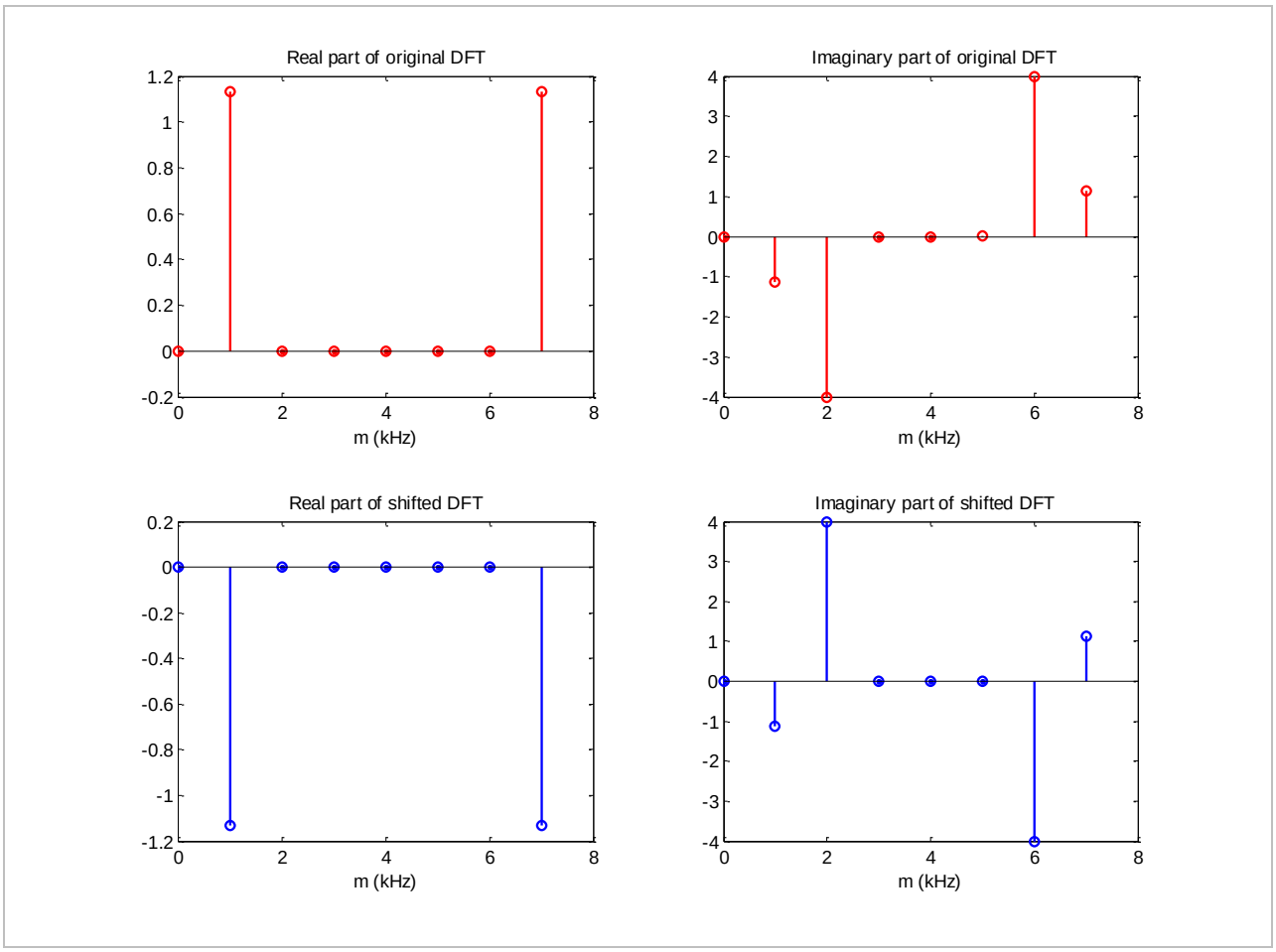

Figure 9. Analysis of original and shifted real and imaginary DFT components.

Part e.

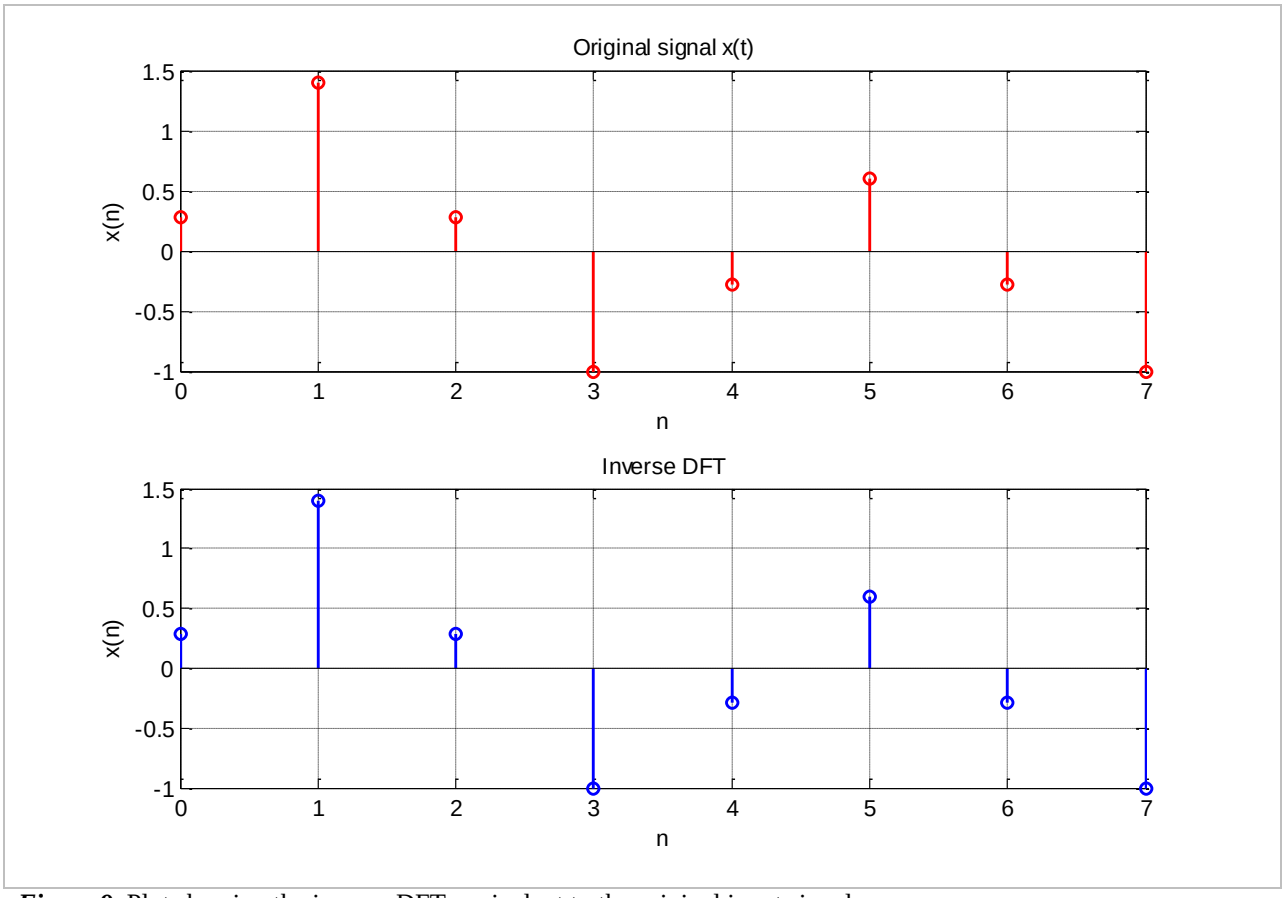

Figure 9. Plot showing the inverse DFT equivalent to the original input signal.