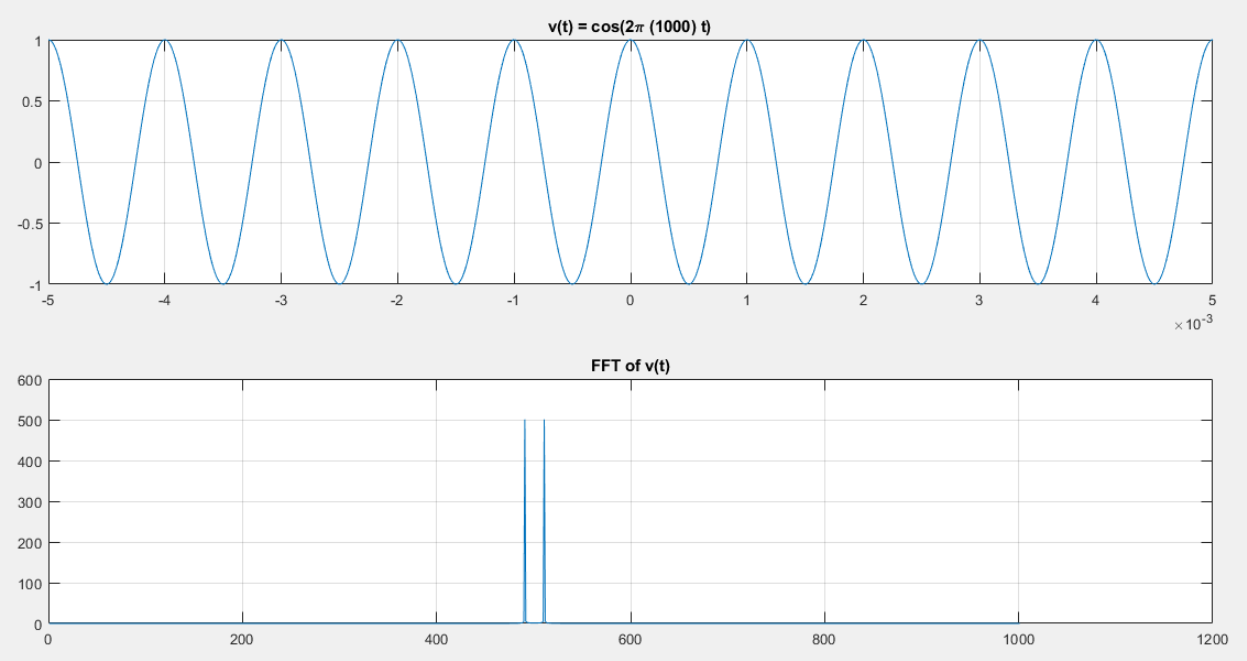
Yonatan Carver
ECES 352

Problem 1

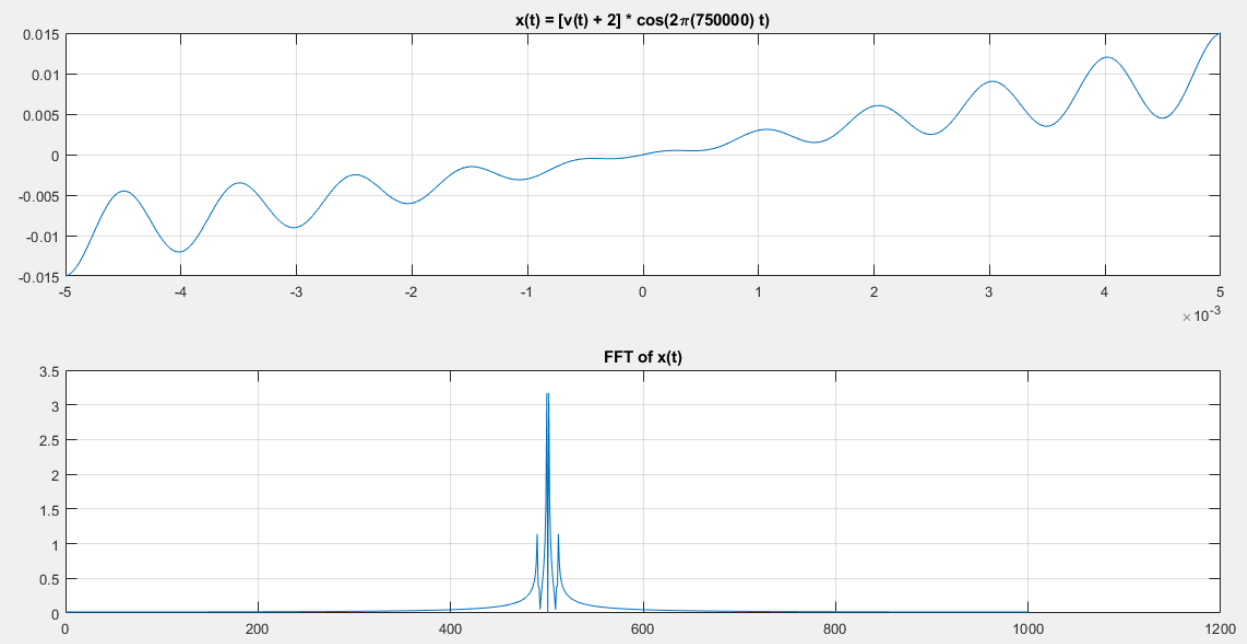
(a)

Problem 2

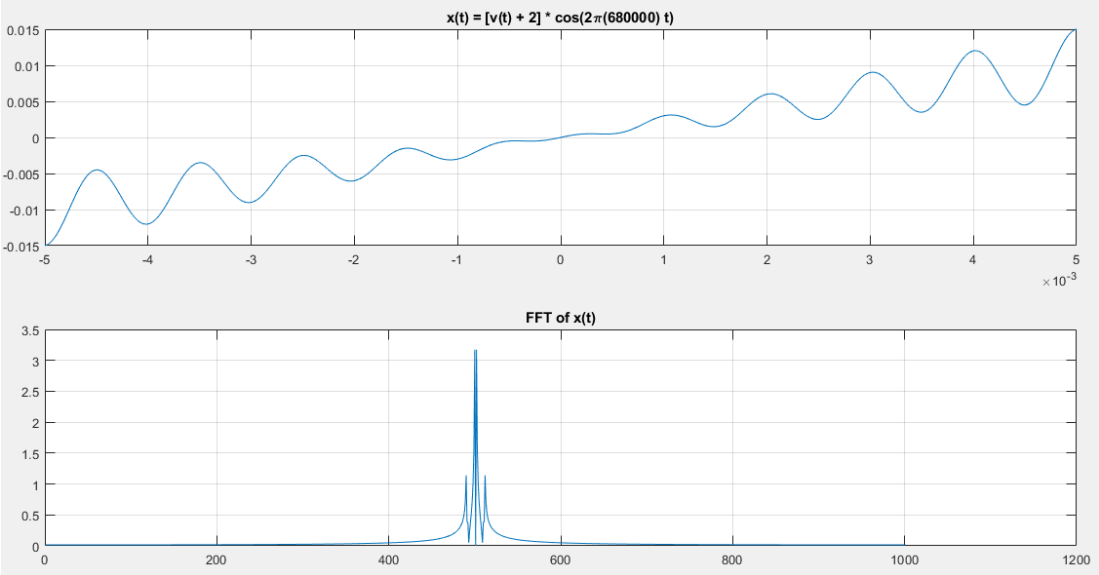
(a)



(b)



(c) The spectrum does not change as the carrier frequency is changed.



Problem 4

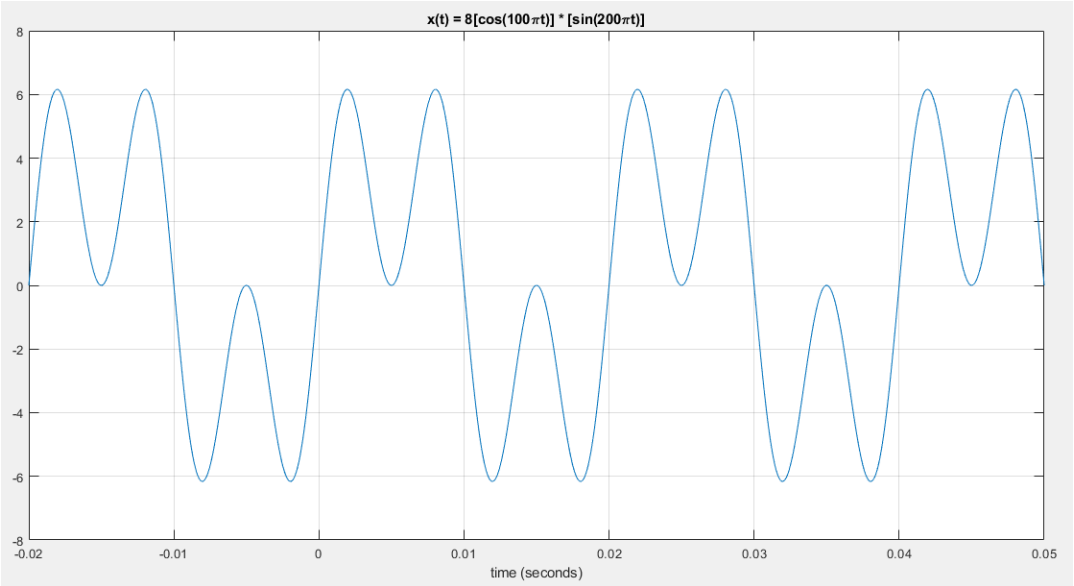
(a)

$$x(t) = 8[\cos(100\pi t)] * [\sin(200\pi t)]$$
$$= 8\left[\frac{1}{2}\left(e^{j100\pi t} + e^{-j100\pi t}\right)\right] * \left[\frac{1}{2j}\left(e^{j200\pi t} - e^{-j200\pi t}\right)\right]$$
$$= \left(4e^{j100\pi t} + 4e^{-j100\pi t}\right) * \left(\frac{1}{2j}e^{j200\pi t} - \frac{1}{2j}e^{-j200\pi t}\right)$$

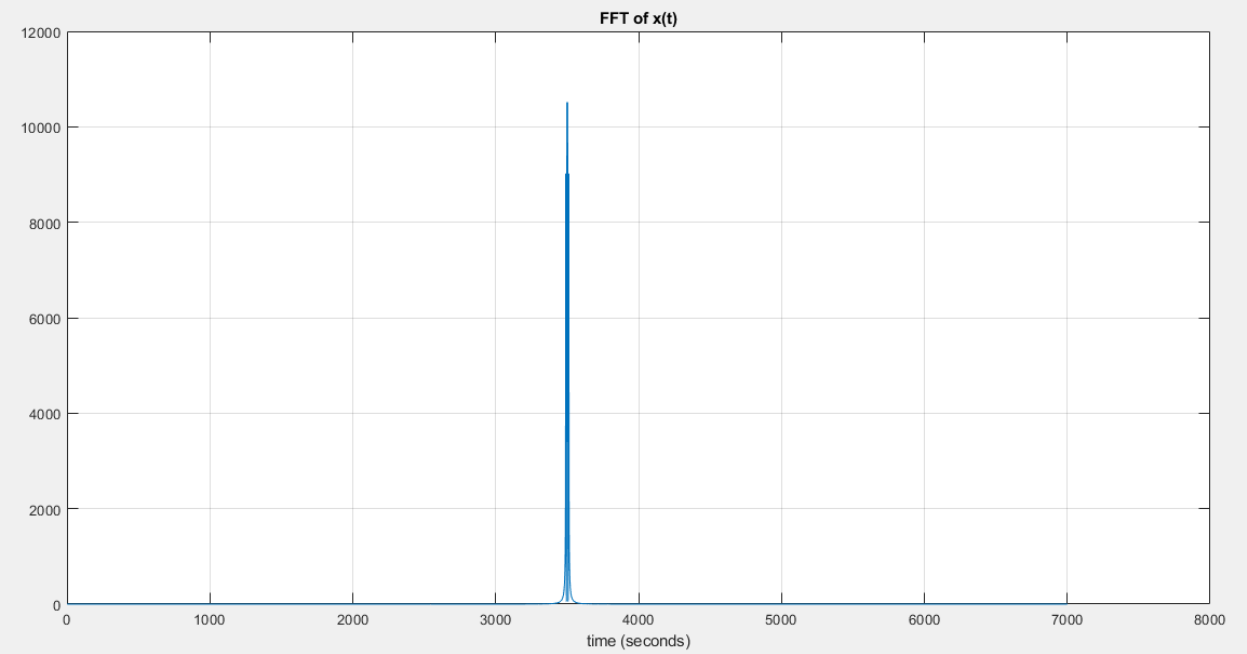
(b)

$$x(t) = 8\cos(100\pi t + 0) * \cos\left(200\pi t + \frac{\pi}{2}\right)$$

(c)

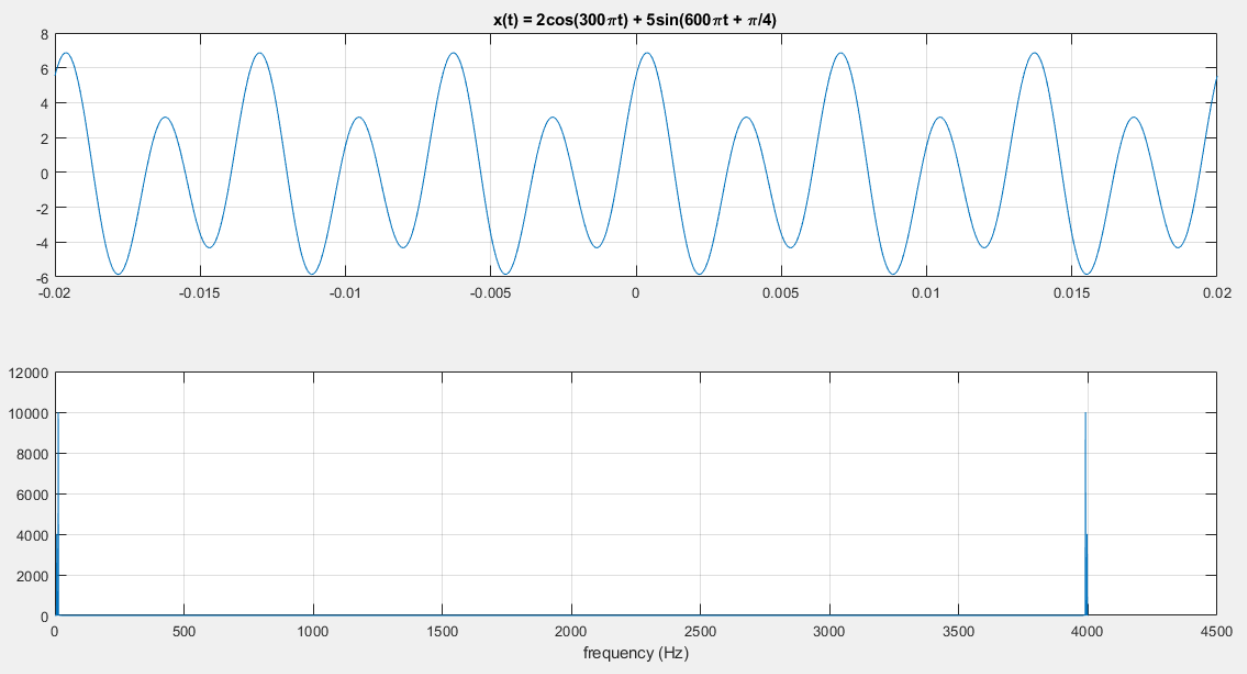


(d)


FFT of x(t)
12000
10000
8000
6000
4000
2000
0
0
1000
2000
3000
4000
5000
6000
7000
8000
time (seconds)

Problem 5

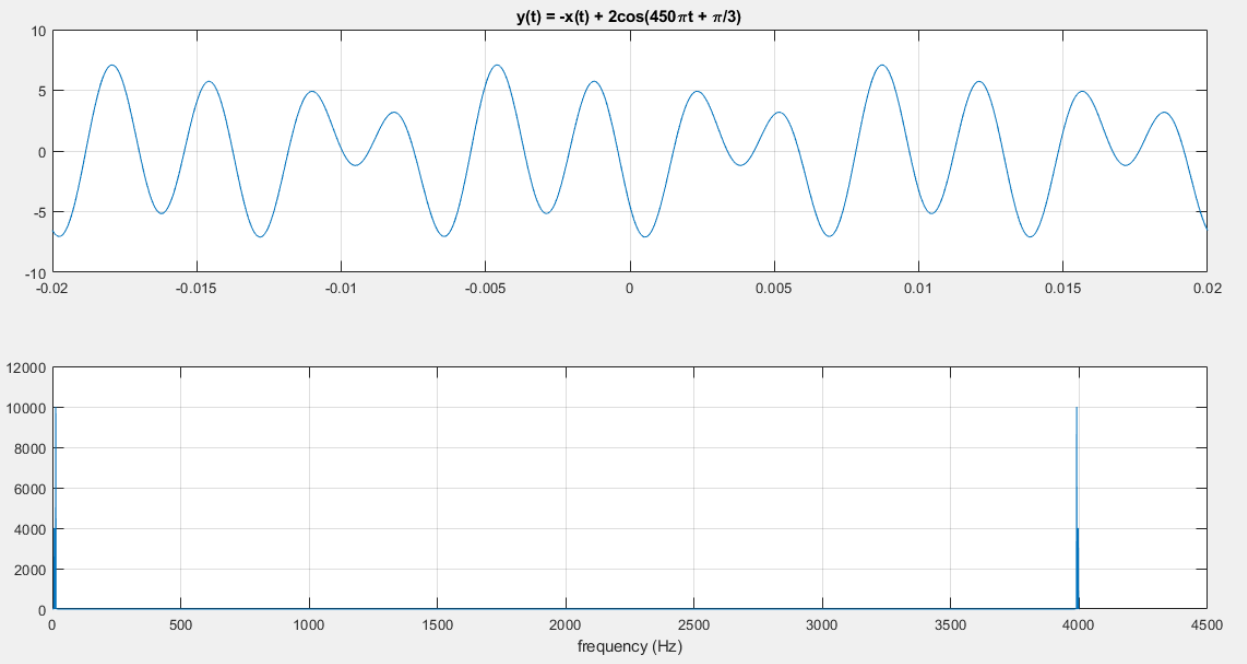
(a)


x(t) = 2cos(300πt) + 5sin(600πt + π/4)
8
6
4
2
0
-2
-4
-6
-0.02
-0.015
-0.01
-0.005
0
0.005
0.01
0.015
0.02
12000
10000
8000
6000
4000
2000
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
frequency (Hz)

(b) x(t) is periodic with period 0.0067. There are harmonics at:

Frequency (Hz)	Power
7	10002
13	4006
3990	4006
3996	10002

(c) The frequency spectrum has not changed. y(t) is periodic with period 0.0133.



Problem 6

(a)

Note name	Note number	frequency
A	49	440
B^b	50	466.16
B	51	493.88
C	52	523.25
C#	53	554.37
D	54	587.33
E^b	55	622.25
E	56	659.25
F	57	698.46
F#	58	739.99
G	58	783.99
G#	60	830.61
A	61	880

(b)

$$f_n = (440Hz) * 2^{\frac{n}{12}}$$

f_n = frequency of note n
n = steps away from 49 (440Hz) (i.e. for note 50, n=1)

Problem 7

(a) $b_k = 6 + 2 * \sum a_k$
(b) $b_k = 3 + \sum a_k$