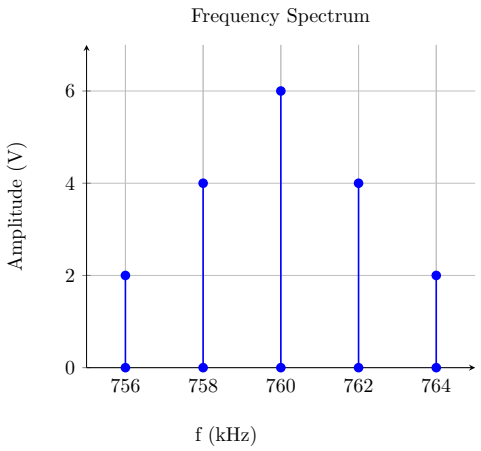
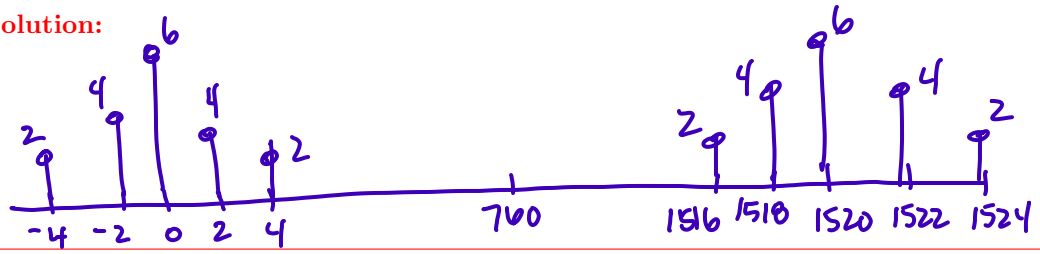
1. This problem walks through the synchronous demodulation process. Given the following AM amplitude spectra:



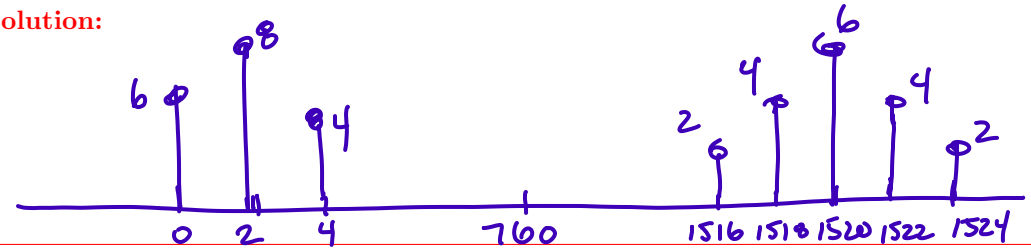
(a) Draw the amplitude spectra after multiplying this signal by $2\cos 360^\circ * 760k * tV$.

Solution:



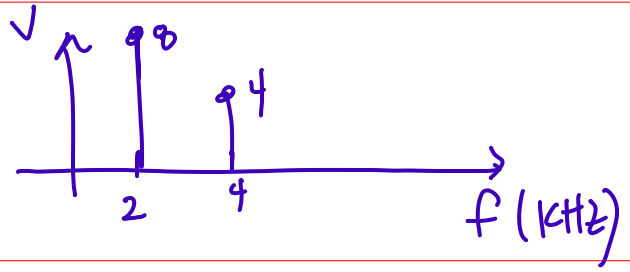
(b) Modify the drawing of Part (a) by folding the negative frequency amplitudes over to the positive frequencies (this will double the amplitudes of the positive frequency components).

Solution:

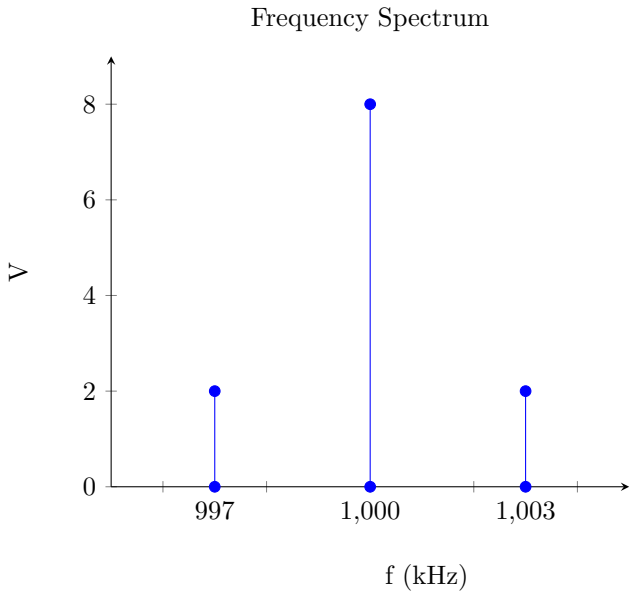


(c) If the signal from Part (b) is used as the input to an LPF with cutoff frequency of 10kHz and a HPF with a frequency of 10Hz, plot the resulting amplitude spectra.

Solution:



2. Given the following amplitude spectra with a single message tone:



(a) If $A_c = 4$V, find B, A_m, and α, and determine if the signal is under or over-modulated.

$B =$ 2V

$A_m =$ 1V

$\alpha =$ 0.5

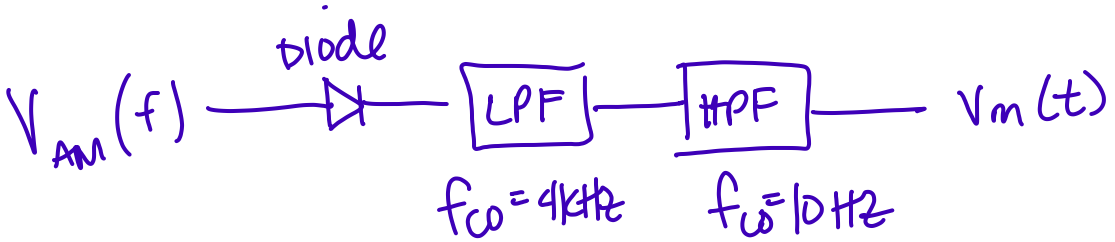
Circle one: Over-modulated Under-modulated

(b) What will be the V_{max} and V_{min} of the time time-domain graph?

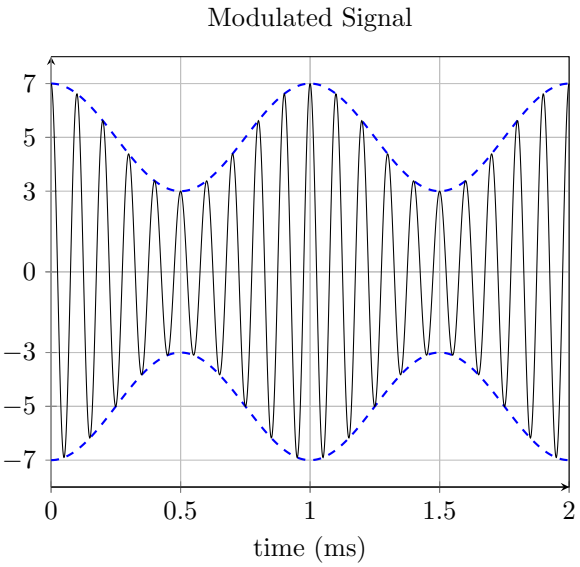
$V_{max} =$ 12V

$V_{min} =$ 4V

(c) Design a suitable envelope detector.



3. Given the following time-domain under-modulated AM signal, which contains a single message tone.



(a) Determine the frequency of the message tone (note the scale of the x-axis).

$f_m =$ 1000Hz = 1 KHz

Solution:

1 KHz $f_m = \frac{1}{T_m}$

(b) Estimate the frequency of the carrier.

$f_c =$ 10kHz

Solution:

10 KHz $T_c = \frac{.5ms}{5}$

(c) If the carrier amplitude is 1V, compute the values of B and A_m.

$B =$ 5

$A_m =$ 2

Solution:

$V_{max} = 7V$

$V_{min} = 3V$

$A_m = \frac{V_{max} - V_{min}}{2A_c}$

$B = \frac{V_{max} + V_{min}}{2A_c}$

(d) Design a suitable synchronous detector. What will be the expression $(A\cos 360° * f * t)$ at the output of the detector?

Solution: