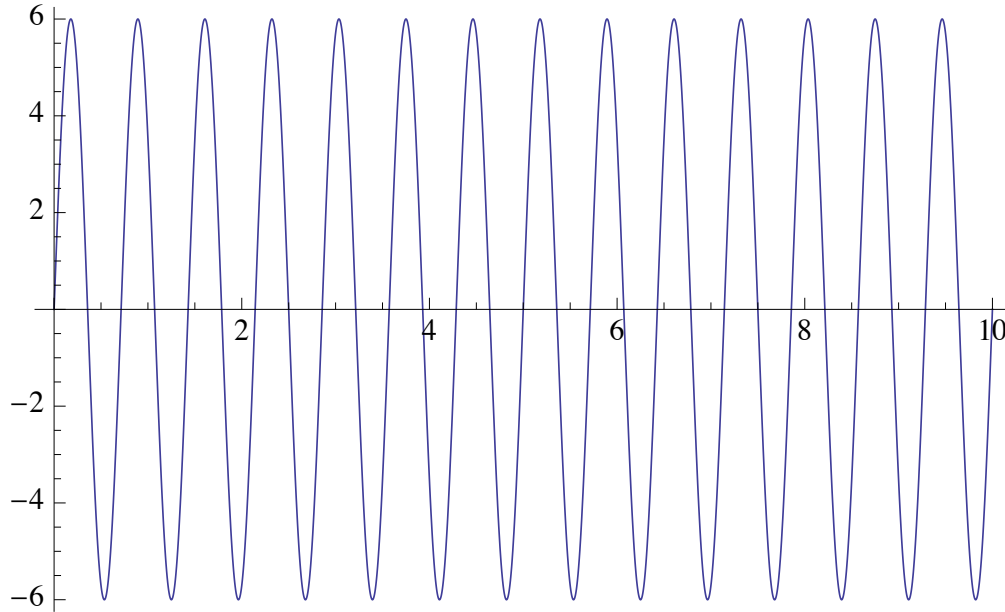


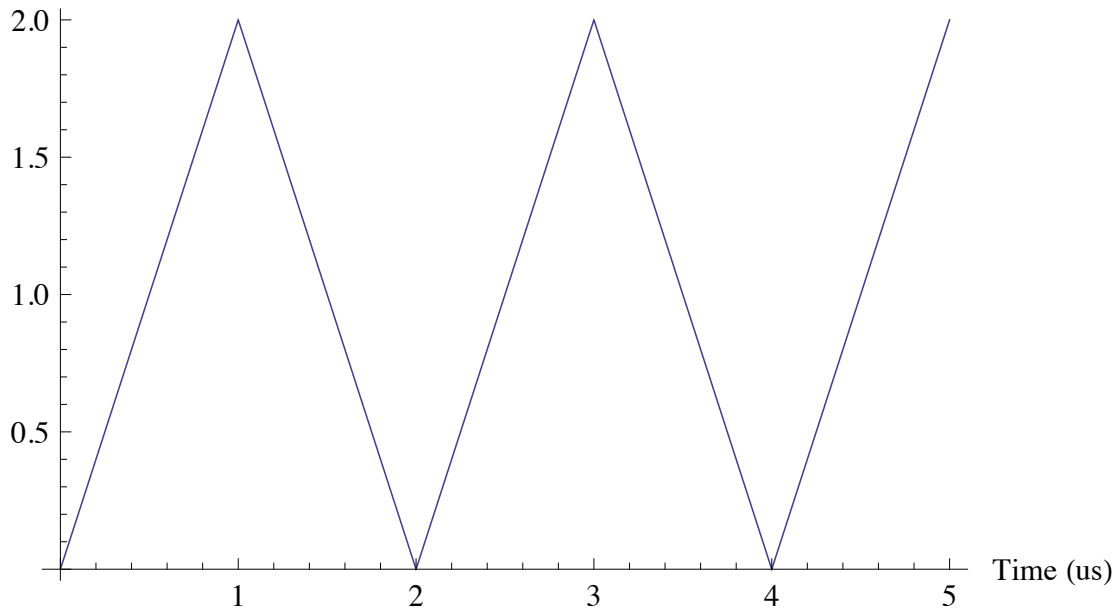
CSCI-E2 BITS - Problem Set 5 (40 points total)
Due April 26th 2011 at Noon

Question 1 (10 points)

(a) (4 points) What is the amplitude and frequency of the following wave?



(b) (6 points) Draw the result of (i) amplitude modulating and (ii) frequency modulating a sine wave of frequency 2 MHz with the following modulation signal (note that the time scale is in micro seconds):



Question 2 (14 points)

You're managing the data transfer on a direct microwave link between two of your company's remote sites. The current system operates at 10.5 GHz, with a bandwidth of 100 MHz and data transfer rate of 10 Mbps.

- (a) (2 points) Calculate the current signal to noise ratio of the transmission.
- (b) (12 points) You wish to improve the channel capacity so that you have a data transfer rate of at least 500 Mbps. You have the following options:
1. Buy a better amplifier to increase your transmitted signal power (each 3 dB of gain will cost an extra \$5000)
 2. Increase the bandwidth of your transmit and receive system. This will cost \$100 / MHz of extra bandwidth.
 3. Cool your receiver in liquid nitrogen to reduce the noise by a factor of 20. This will cost you \$10,000 over the lifetime of the system.

Which one do you choose? Explain in detail your reasoning for your choice.

Question 3 (16 points)

(a) (8 points) Watch the video available for download from the course website of a propeller speeding up and slowing down. Explain in detail what you see and why this is happening. What is the name of this effect?

(b) (8 points) Assume the maximum speed of the propeller is 3000 revolutions per minute (rpm). How should you change the video frame rate (currently at 30 frames per second) so that the inner black line always appears to be rotating clockwise?