**Laboratory 2**

**Lab Report Outline**

Your lab report will include the following sections:

1. Title Page
2. Abstract - maximum of 300 words
3. Objectives
4. Introduction and Motivation
5. Background Material (includes any theoretical background)
6. Results and Discussion
7. Conclusion
8. Appendices - put listings of MATLAB code in the Appendices. Put any other Appendices you see fit.

You are free to use MATLAB code from previous labs.

**Signal Generation**

1. Generate and plot the signal x(t) = u(t+20) – u(t-20) where u(t) is the unit-step. Use a spacing between time samples of 0.01 and show the plot for -25 < t < 25.
2. One period of a square wave is described as follows. The value is +1 for 0 ≤ t < 5. The value is -1 for 5 ≤ t < 10. Plot three periods of this square wave (0 ≤ t ≤ 30). Use a spacing between time samples of 0.01.
3. Consider x(t) = 2 sin(250πt – pi/5). Plot this signal for 0 ≤ t ≤ 0.3. Use a spacing between time samples such that at least 20 points are plotted in one period.

**Chirps**

Pure tones or sinusoids are not very interesting to listen to. Modulation and other techniques are

used to generate more interesting sounds. Chirps, which are sinusoids with time-varying frequency, are some of those more interesting sounds. For instance, a chirp signal is expressed as x(t) = Acos(Ω0 t + s(t))

1. Let A = 1, Ω0 = 2 and s(t) = t2/4. Use MATLAB to plot this signal for 0 ≤ t ≤ 40 seconds in steps of 0.05 second.
2. Let A = 1, Ω0 = 2 and s(t) = −2 sin(t). Use MATLAB to plot this signal for 0 ≤ t ≤ 40 seconds in steps of 0.05 seconds.
3. What is the frequency of a chirp? It is not clear. The instantaneous frequency IF(t) is the

derivative with respect to t of the argument of the cosine. For instance, for a cosine cos(Ω0 t),

the IF(t) = Ω0 so that the instantaneous frequency coincides with the conventional

frequency. Determine the instantaneous frequencies of the two chirp signals and plot them.

**Beating or Pulsation**

An interesting phenomenon in the generation of musical sounds is beating or pulsation. Suppose

NP different players try to play a pure tone, a sinusoid of frequency 160 Hz, and that the signal

recorded is the sum of these sinusoids. Assume the NP players while trying to play the pure tone

end up playing tones separated by Δ Hz, so that the recorded signal is

where the fi are frequencies from 159 to 161 equally separated by Δ Hz. Each player plays at a different frequency.

Write a MATLAB function to plot the signal x(t) for 0 ≤ t ≤ 200 (seconds) in MATLAB where t is incremented in steps of 0.1. Let each musician play a unique frequency. The input arguments are t and the number of players NP. The output is x(t). You need to calculate Δ which depends on NP. Plot x(t) for NP = 51 and NP = 101. Record your observations.