ECE 410 Introduction to Signal Processing

Matlab Project II

Fall 2003

Issued: Monday September 8, 2003 **Due:** Monday, September 15, 2003

The purpose of this project is to give you some practice with the discrete time Fourier transform and to provide a brief introduction to the `fft` command. We will study how the `fft` works later in the semester.

Each student must do his or her own work on this project, however you may ask other students for advice. As stated in the guidelines given in the ECE 410 course information packet, you should identify any students you collaborate with. Your writeup must include all of the analytical (*i.e*, pencil/paper) work, Matlab plots and code, and relevant explanations. A list of guidelines for preparing the writeup of this project are given below.

- The report must be neatly handwritten or typed, and all pages must be numbered.
- All plots must be neatly annotated with x-axis and y-axis labels and a title. Any graph not labeled will be considered not handed in.
- I will not spend time trying to figure out which graphs are for which problems. When referring to plots in the text, I recommend doing at least one of the following:
  - use figure numbers, e.g., "Figure 1 is a plot of the signal $x[n]$."
  - cite the page number they are on, e.g., "The figure at the top of page 4 is a plot of $x[n]$."
- All Matlab code must be well-documented and should be included in an appendix at the end of the report.

Telephone Touch-Tone

Do the Basic and Intermediate problems in Section 5.2 of *Computer Explorations in Signals and Systems* by Buck, Daniel, & Singer. Your writeup should include answers to all of the questions in the book and any other observations you make as you complete the exercises.

Additional instructions:

- For better sound, you may want to use the `soundsc` command, which automatically scales the sound vector before playing it. This will play the sound as loud as possible without clipping.
- The command `fft(x,N)` produces N samples of the DT Fourier Transform, evenly spaced between 0 and 2π. In other words the spacing between samples is $\frac{2\pi}{N}$, and the first sample is at 0. If you use the `fftshift` command, as suggested in part e, the samples will be reordered to start at $\omega = -\pi$. The spacing between samples is the same, *i.e.*, $\frac{2\pi}{N}$. If you want to plot the output of `fftshift`, you will need to define another `omega` vector, one that starts at $-\pi$ and ends at $\pi - \frac{2\pi}{N}$.