The purpose of this short project is to review discrete-time filtering of periodic signals. These examples should reinforce your understanding of frequency response. 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.

1 **First-Order Recursive Discrete-Time Filters**

Do all the problems in Section 3.8 of *Computer Explorations in Signals and Systems* by Buck, Daniel, and Singer. Your solutions should include answers to all of the questions in the book, the required plots, and your Matlab code. exercises, along with the plots, Matlab code.

2 **Hints**

- You may find it useful to review Section 3.6 in *Signals and Systems* by Oppenheim and Willsky with Nawab (your ECE 320 textbook). Section 3.6 discusses Fourier series representations of discrete-time periodic signals.
- Note that in part c, you must define the vector $\mathbf{a}_x$ where the elements of $\mathbf{a}_x$ are the Fourier series coefficients $a_k$ for $0 \leq k \leq 19$. It will be helpful to remember that you can think of the DFS coefficients as being periodic with period $N = 20$, thus $a_k = a_{k+N}$. (Your Matlab book also points out this fact in tutorial 3.1.)
- In part e, you should limit the axes of your plot to only show the output for $0 \leq n \leq 99$. By looking at only this section, you will ignore the transient response of the filters.