HW 4 **ECE-GY 6113** **Fall 2021**

From the Signals Exercises packet:

1.6.9, 1.8.10, 1.8.19, 1.8.22, 1.9.3, 1.9.12,
1.10.1, 1.10.5, 1.11.1, 1.11.4

MATLAB Part

1) **Simple system design**

See the document system_design_problems.pdf with two exercises.

2) **Baseline drift correction using dc notch filter**

Download the ECG data file **ecg_lfn.txt**.
The sampling frequency is 1000 samples/second.
Import into Matlab using x = load('ecg_lfn.txt');
Plot the ECG signal and observe the baseline drift. Design a first-order recursive filter with a frequency response null at omega = 0, and a pole on the positive real axis. This system is a dc-notch filter. Apply your dc-notch filter to the ECG data to remove the baseline drift. Try not to overly distort the ECG signal itself. Evaluate the effectiveness of the filter by overlaying the filtered signal with the original ECG signal in the same plot. Show the pole-zero diagram, impulse response, and frequency response of your filter. Give comments on your results and observations.

3) **60 Hz notch filter for ECG signal**

The data file **ecg2x60.txt** contains ECG data recorded at a sampling rate of 200 samples per second. There is 60 Hz additive interference on the signal. In this exercise you are to design two notch filters to remove the 60 Hz interference and apply the filters to the data.
(1) Design a filter implemented as a second-order non-recursive filter (i.e., an FIR filter).
(2) Design a filter implemented as a second-order recursive filter (i.e., an IIR filter).
In each case, show the pole-zero diagram, frequency response, and impulse response of the filter. Show the output signal obtained by filtering the provided ECG data by each of your two filters. Do the filters remove the 60 Hz interference? Does one filter give a more accurate output than the other? Give comments on your results and observations.