% Tune-Up #6 - Fall 2024 - ECE 313 Linear Systems & Signals - Evans

% Copy this file into a Matlab script window, add your code and

% answers to the questions as Matlab comments, hit "Publish", and

% upload the resulting PDF file to this page for the tune-up

% assignment. Please do not submit a link to a file but instead

% upload the file itself. Late penalty: 2 points per minute late.

% Homework problem 6.1(a).

% For the first-order unnormalized averaging filter (lowpass filter)

A graph with blue dots and numbers

Description automatically generated% y[n] = x[n] + x[n-1]

% and the initial condition x[-1] = 0

% as a necessary condition for LTI

% system properties to hold.

% Determine the formulas for, and

% plot in MATLAB, the following:

% i. impulse response

% h[n] = d[n] + d[n-1] where d[n]

% is the discrete-time impulse signal

h = [ 1 1 0 0 0 ];

n = [ 0 1 2 3 4 ];

stem(n, h, 'LineWidth',2 );

A graph with blue lines

Description automatically generatedylim( [-0.5 1.5] );

xlim( [-0.5 4.5 ] );

% ii. step response

% ystep[n] = u[n] + u[n-1]

stepsignal = [ 1 1 1 1 1 1 1 1 ];

ystep = filter( [1 1], 1, stepsignal );

n = [ 0 1 2 3 4 5 6 7 ];

figure;

stem(n, ystep, 'LineWidth',2 );

ylim( [-0.5 2.5] );

xlim( [-0.5 7.5 ] );

A graph of a normalized frequency

Description automatically generated

% iii. Plot the magnitude and phase of

% the frequency response using freqz.

% H( exp(j w) ) = 1 + exp(-j w)

figure;

freqz( [ 1 1 ] );

% Magnitude response: Vertical axis is in

% deciBels. AdB = 20 log10(A). A linear

% of a 1 equals 0 dB. In the magnitude

% plot, low frequencies pass through

% with gain (at or above 0 dB) and very

% high frequencies (close to pi) are

% attenuated. Lowpass filter.

% Phase response: A line with a slope of

% -1/2 if the phase were plotted in rad.