ECE 5530/6530 Digital Signal Processing
Matlab Exercise 4

Submission guidelines (READ CAREFULLY)

- All submissions must be done using Canvas.
- The submission should contain a single zip file which contains the report (html) and code (matlab files).
- Scanned hand written submissions will be accepted; however, it is the student's responsibility to ensure that the answers are easily legible. Otherwise, you may lose points.
- MATLAB code should be submitted as part of the code (zip) file. A brief description of the code and how to run it should be included in the html report.
- If a question asks for plots, these should be generated by MATLAB (not handdrawn) and included in the html report.
- For late policy refer to syllabus.
- Unless otherwise specified, all MATLAB exercise questions refer to the dataset described in the first MATLAB exercise. We will indicate questions which use other data explicitly with the text **Other dataset**.

Module 4 - Frequency Analysis of Discrete-Time Systems

1. Write a function `X = dfs(x, N)` to compute the Discrete Fourier Series (DFS) coefficients of a periodic 1-D signal, where x is one period of the signal and N is the fundamental period. Let $x(n) = [0\ 1\ 2\ 3], N = 4$. Find the DFS coefficients using your function.
2. Implement another function `x = idfs(X, N)` to compute the Inverse Discrete Fourier Series (IDFS), where X is the DFS coefficient array and N is the fundamental period. Use the function `idfs` to retrieve back the original signal $x(n)$ from the results of the previous part.
3. The difference equation of a filter is given as $y(n) = -0.8\ y(n-1) + 0.2\ x(n)$. Find its frequency response, plot the magnitude and phase responses, and state what type of a filter it is.
4. A 3rd-order lowpass filter is described by the difference equation $y(n) = 0.01\ x(n) + 0.05\ x(n-1) + 0.05\ x(n-2) + 0.01\ x(n-3) + 1.75\ y(n-1) - 1.18\ y(n-2) + 0.28\ y(n-3)$. Plot the magnitude and the phase responses of this filter and verify that it is a lowpass filter.