ECE 310: Quiz #8 (10am Section G) Fall 2018

UIN: _____

Name: _____ **Score:** _____

1. (4 pts) Consider the signal $\{x[n]\}_{n=0}^{3} = \{1, -1, 2, -2\}$. Use a decimation-in-time radix-2 FFT to compute the DFT of $x[n]$, i.e., calculate explicitly all the intermediate quantities that are computed in this FFT, and show how they are combined to produce the final output, which you should also give explicitly

2. (3 pts) Given $\{x[n]\}_{n=0}^{N-1}$, with $x[n] = x_c(nT)$ and $T = 100\mu$sec, you compute a length-N FFT of $x[n]$ and plot the magnitude. Using this method, you wish to resolve analog sinusoidal signals that are separated by as little as 5 Hz in frequency. Assume that the frequency resolution for windowed DTFT-based spectral analysis is equal to the width of the main lobe of the DTFT of the window. Determine the minimum length $N = 2^\nu$ that will meet your resolution requirement. (**Hint**: The DTFT of the sequence $v[n] = u[n] - u[n-N]$ is $V_d(\omega) = e^{-j\omega(N-1)/2}\frac{\sin(N\omega/2)}{\sin(\omega/2)}$)

3. (3 pts) Let $\{x[n]\}_{n=0}^{2} = \{2, 4, 5\}$ and $\{v[n]\}_{n=0}^{2} = \{1, 0, -1\}$. A new sequence $\{g[n]\}_{n=0}^{3}$ is generated as follows: $\{g[n]\}_{n=0}^{3} = \text{IFFT}\left(\{G[k]\}_{k=0}^{3}\right)$ where the IFFT is a 4-point inverse FFT, $G[k] = X[k]V[k], k = 0, 1, 2, 3$, and the sequences $X[k]$ and $V[k]$ are generated each by a 4-point FFT of the sequences $\{x[n]\}$ and $\{v[n]\}$, respectively, after zero padding them to length 4. Determine $g[1]$ and $g[3]$