ECE 158 Fall Quarter 2006
Gibson **11/06/06**

Mid-Term Exam

Instructions: Do all problems. Show all work. Problems are weighted as shown.

1. (10) A length-4 sequence x[n] = { 1 2 0 1} has the DFT G[k] = { 4 1-j -2 1+j}. Demonstrate that Parseval's Relation holds for this sequence.

2. (20) An FIR filter has the impulse response h[n] = { 1 2 3 }. Find the output y[n] for the input x[n] = { 1 2 2 1}.

3. (20) Find the circular convolution of h[n] and x[n] given in Problem 2.

4. (20) Given that H[k] = { 6 -2-j2 2 -2+j2 } and X[k] = { 6 -1-j 0 -1+j } for the h[n] and x[n] sequences in Problem 2, find H[k]X[k] and take the IDFT using the 4x4 IDFT matrix. How does this result relate to the answers to Problems 2 and 3?

5. (10) A periodic sequence of length 10 has the DFT

$$X[k] = \sum_{n=0}^{4} W_{10}^{kn}$$

Find a closed form expression for this finite sum and find the magnitude spectrum.

6. (20) Consider an infinite sequence $x[n] = \cos \omega_1 n + \cos \omega_2 n$. We truncate this sequence to L samples in the range $0 \le n \le L-1$. Write an expression for the DTFT of the truncated sequence in terms of the DTFT of the length-L rectangular window function $W(\omega)$. What happens if $|\omega_1 - \omega_2| < 2\pi / L$? Sketch the DTFT of the truncated sequence when $|\omega_1 - \omega_2| > 2\pi / L$.