MA 439 - Math of Image Processing
Worksheet #3

Professor Broughton

Name:_____ Box #:_____

Do not hand in

1. Write out F_4 the 4×4 Fourier transform matrix.

2. Let X be the signal $X = [0, 1, 2, 1]$ compute $\widehat{X}$.

3. Plot X and its periodic extension to the sample point 1. What properties does X have. What properties does $\widehat{X}$ have.

4. Repeat 2 and 3 for $X = [0, -2, 0, 2]$.

5. Compute $F_4^* F_4$ and use this information to determine F_4^{-1}.

6. What matrix formula should one use to compute X from $\widehat{X}$. Carry out the computation for the X given in 2.

For the remaining questions let X be the signal obtained by sampling $f(t) = 2 + 0.5\cos(10\pi t) - .075\sin(24\pi t)$ at the points n/N for $n = 0, \ldots N-1$.

7. Let $N = 128$. Write out X as a sum of E_k 's where $0 \leq k \leq N-1$.

   $X =$

8. let X and N be as in 7. Compute all the nonzero $\widehat{X}(k)$ for $0 \leq k \leq N-1$. Use the dot product relations.

9. Now let $N = 16$, and let X be as previously defined. Write out X as a sum of E_k 's where $-\frac{N}{2} < k \leq \frac{N}{2}$.

   $X =$

10. Let X and N be as in 9. Compute all the nonzero $\widehat{X}(k)$ for $-\frac{N}{2} < k \leq \frac{N}{2}$. Use the dot product relations.