MAT 312 Spring 2009 Homework 11

Using $\omega = e^{i\frac{\pi}{4}}$ as your primitive 8-th root of 1, compute the Discrete Fourier Transforms $\mathbf{c} = (c_0, c_1, c_2, c_3, c_4, c_5, c_6, c_7)$ of the following vectors. In each case, calculate also the vector of absolute values $(|c_0|, |c_1|, |c_2|, |c_3|, |c_4|, |c_5|, |c_6|, |c_7|)$.

1. $\mathbf{f} = (-1, -1, 1, 1, 1, 1, -1, -1)$
2. $\mathbf{f} = (-1, -1, 1, 1, -1, -1, 1, 1)$
3. $\mathbf{f} = (-1, 1, -1, 1, -1, 1, -1, 1)$

It will be easiest to work with the matrix $\Omega = (\omega^{mj})$ (see p. 445) keeping the entries as powers of ω, so as to be able to use the identities $\omega^4 = -1$, $\omega^5 = -\omega$, $\omega^6 = -\omega^2$, $\omega^7 = -\omega^3$ to simplify the expression for c_i before evaluating the sum using $\omega = \frac{\sqrt{2}}{2} + i\frac{\sqrt{2}}{2}$, etc.