8.511 Theory of Solids I **Problem Set 7** **Due November 2, 2004**

1. **Marder, Chapter 17, Problem 6**

   To do this problem, you may start with the following equation relating the heat current density j_Q and the charge current density j.

$$j_Q = \Pi j - \kappa \frac{\partial T}{\partial x} \tag{1}$$

   where Π is the Peltier coefficient and κ the thermal conductivity. We assume $\Pi_p > 0$ and $\Pi_n < 0$.

2. (a) Write down an expression for the ground state energy E_N of an N interacting electron system in the Hartree-Fock approximation. Note that it is not equal to the sum of one electron eigenvalues.

   (b) Suppose the electron occupying the ith eigenvalue ε_i is removed, leaving an $N - 1$ electron system with energy $E_{N-1}(i)$. The energy difference $E_N - E_{N-1}(i)$ is called the ionization energy E_i. Assuming the rest of the eigenvectors are unchanged, show the ionization energy equals ε_i. This is called Koopman's Theorem.