The due date for this assignment is Thursday February 15.
Reading assignment: Section 22. of Ashcroft and Mermin or chapter 4 of Kittel.

1. **Diatomol linear chain**: Consider a linear chain in which alternate ions have masses $M_1$ and $M_2$ and only nearest neighbors interactions. Use the equation of motion derived during class and determine the dispersion relation, $\omega_n^2 (k)$, for the two normal modes of the system where $\kappa$ is the spring constant. Discuss the form of the dispersion relation and the nature of the normal modes when $M_1 \gg M_2$. Determine the dispersion relation when $M_1 \rightarrow M_2$ and compare the result with that of the monatomic linear chain.

2. In a linear chain of lattice spacing $a_0$, particles of mass $M$, are connected by first-neighbor springs of spring constant, $\kappa$. In addition to the elastic forces, each particle is subjected to a damping force, $F = -\Gamma \frac{du_n}{dt}$, where $u_n$ is the displacement of the nth particle from the equilibrium position, and $\frac{du_n}{dt}$ is its velocity. How does the damping change the frequencies, $\omega = \omega (k)$, and what is the relaxation time of the modes? Assume $\Gamma^2 \ll \kappa/M$, and discuss the $k \simeq 0$ and $k \simeq \frac{\pi}{a}$ modes separately.