**ME213 Homework set6**

**Problem 1**

(a) At high temperature the iron oxidizes at a linear rate. The addition of more than 12% Cr decreases the rate of oxidation significantly, and leads to an oxidation rate that is parabolic. Explain this result, which is a key feature in the behavior of stainless steels.

(b) Why is the coefficient of thermal expansion of the protective coating an important issue?

**Problem 2**

(a) Draw a simple sketch of the band diagrams of an n-type and a p-type semiconductor. Indicate the position of the Fermi level relative to the center of the band gap in each material at moderate temperature.

(b) Roughly sketch the band structure of an n-p junction in which the two materials are joined and allowed to come to equilibrium.

(c) Explain qualitatively why the n-p junction conducts electricity much more easily in one direction

than in the other.

**Problem 3**

(a) A material that is made of atoms that have permanent magnetic moments must be paramagnetic, ferromagnetic or antiferromagnetic. Describe these three magnetic states. Which do you expect at high temperature?

(b) Describe the difference between a "hard" and a "soft" ferromagnet. Why is a hard magnet hard?

(c) If you were choosing a material for a magnetic disc to store information, would you prefer a hard or a soft ferromagnet? Would you want to coat the disc with small, discrete particles or with a continuous ferromagnetic film?