

ME/MS 260A Homework 1

Micromechanics - Spring 2013-14

Due: April 10, 2014 in class

Guidelines

The homework is due on Thursday April 10, 2014 in class. No late homeworks will be accepted without instructor's prior permission. Some problems may be open ended and left for the student to explore on their own. Standard honor code rules apply.

1. Ising Model

You may refer to Statistical Mechanics: Entropy, Order Parameters and Complexity by James P. Sethna or any other suitable reference for the following.

- i Write a short note about Ising model
- ii Read and describe Metropolis algorithm for solving Ising model problem.
- iii Download the software mentioned in the class for Ising model from <http://pages.physics.cornell.edu/~sethna/teaching/sss/ising/ising.htm>. Get the SSS software for your operating system. Run the ising program and play around with the software.
- iv Start with external magnetic field $H = 0$. Roughly locate T_c for this H . Now repeat the process for atleast two values of $H \neq 0$. Does T_c change with H ? Explain.

2. Crystal lattice symmetry

Consider a 2-dimensional Bravais lattice. Show that the point group or the symmetry group is

$$P(e_i) = R : Re_i = \mu_i^j e_j$$
$$= \begin{cases} \{R_0, R_{\frac{\pi}{3}}, R_{\frac{2\pi}{3}}, R_{\pi}, R_{\frac{4\pi}{3}}, R_{\frac{5\pi}{3}}, R_{2\pi}\} & \text{if } |e_1| = |e_2|, \frac{e_1 \cdot e_2}{|e_1||e_2|} = \frac{1}{2} \text{ a triangular lattice} \\ \{R_0, R_{\frac{\pi}{2}}, R_{\pi}, R_{\frac{3\pi}{2}}, R_{2\pi}\} & \text{if } |e_1| = |e_2|, \frac{e_1 \cdot e_2}{|e_1||e_2|} = 0 \text{ a square lattice} \\ \{R_0, R_{\pi}\} & \text{otherwise} \end{cases}$$

Classify possible martensitic phase transitions in 2D lattices. Which ones are reconstructive?