

## **MS 133 Kinetic Processes in Materials**

**? Tu Th 9-10:25 AM 102 Spalding ?**

### Instructors:

**April: B. Fultz** (138-78, x2170, Room 239 Keck) btf@caltech.edu

**May: J. Kornfield** (210-41, x4138, Room 229 Spalding) jak@cheme.caltech.edu

### Teaching Assistants:

First Half: TBA

Second Half: TBA

### Book:

P. G. Shewmon, Diffusion in Solids, The Minerals, Metals, and Materials Society (1989).

### Other Books:

1. M. Doi and S. F. Edwards, Theory of Polymer Dynamics, Oxford (1986).
2. J. M. Smith, Chemical Engineering Kinetics, 3<sup>rd</sup> ed., McGraw-Hill (1981).
3. J. W. Christian The Theory of Transformations in Metals and Alloys, Pergamon (1981).

### Grading:

Students may elect to take this course either Pass/Fail or for Letter Grade.

#### Determination of Grades:

Homework (do not look at old assignments, late problem sets will receive 1/3 credit, students may discuss problem solutions verbally, but may not show each other any written work).

From Zero to One Exam (None for Fultz material, perhaps one for Kornfield material, possibly closed book.)

## Tentative Syllabus of MS 133

### **April - Fultz**

- 1) Kinetic Master Equation
- 2) Kinetic Master Equation and Fick's Laws
- 3) Gaussian solution, error function solution
- 4) Fourier series solution
- 5) Bessel function solution
- 6) Correlated random walk/correlation factor for vacancies on triangular lattice
- 7) Correlations in vacancy-solute binding/Mechanism of diffusion
- 8) Diffusion in ionic crystals
- 9) Correlations in ordered alloys
- 10) Experimental methods
- 11) Diffusion in a concentration gradient
- 12) Diffusion in a potential gradient
- 13) Vineyard Theory

### **May - Kornfield**

- 1) Molecular interactions in complex fluids of various densities.
- 2) Reptation model of diffusion of polymer chains.
- 3) Relaxation times.
- 4) Order of rodlike molecules.
- 5) Phase transitions of rodlike molecules.
- 6) Liquid crystals - flow processing and defect structures.
- 7) Flow and mixing of multiphase fluids.