MS/ME 503 Kinetic Processes in Materials
Spring 2017

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Lectures: M, W: 10.10AM – 11.55AM
Location: EPC 204
Office hrs: 1-2 PM Friday, other times by appt.

Required Textbook:

Other Suggested Readings:
Essentials of Materials Science and Engineering, D. R. Askeland, and P. Phule
Diffusion in Solids, P. G. Shewmon
Chemical Kinetics, K. J. Laidler
Phase Transformations in Metals and Alloys, D. A. Porter and K. E. Easterling

Grading:
There will be 2 midterms and a final. The final is NOT cumulative. The grading will be as follows:

Midterm I - 35%
Midterm II - 30%
Final exam - 35%

Homeworks:
3 HW sets will be handed out, one for each exam. They will not be collected or graded. Solution sets will be handed out, and will be discussed in class before each exam.
# Syllabus

## I THERMODYNAMICS VERSUS KINETICS
1. Introduction to chemical thermodynamics  
   1 lecture
2. Phase diagrams, driving force, flux  
   1 lecture

## II TRANSPORT KINETICS
3. Fick’s first and second laws of diffusion, thin film solution  
   1 lecture
4. Error function solution, thick film solution  
   1 lecture
5. Solutions using Laplace transforms, diffusion into a sphere  
   1 lecture
6. Interdiffusion  
   1 lecture
7. Different types of diffusivities, vacancy vs int mechanism  
   1 lecture
8. Diffusion in ionic crystals  
   1 lecture
9. Gas phase diffusion, multipath diffusion  
   1 lecture

## III KINETICS OF CHEMICAL REACTIONS
10. Chemical reactions, order of reactions, activation theory  
    1 lecture
11. Gas/solid, gas/liquid kinetic processes  
    1 lecture
12. Mixed rate control: etching, CVD  
    1 lecture

## IV ROLE OF KINETICS ON MICROSTRUCTURE
13. Capillarity forces on surfaces, grain growth  
    1 lecture
14. Surface energy anisotropy  
    1 lecture
15. Particle coarsening, sintering  
    1 lecture

## V KINETICS OF PHASE TRANSFORMATIONS
16. Homogeneous and heterogeneous nucleation, growth  
    1 lecture
17. Combined nucleation and growth  
    1 lecture
18. Solidification  
    1 lecture
19. Spinodal decomposition  
    1 lecture