# MS/ME 503 Kinetic Processes in Materials
Spring 2015

**Prof. S. N. Basu**
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**Lectures:** **T, R: 10AM – 12Noon**
**Location:** **EPC 204**
**Office hrs: 1-2 PM Friday, other times by appt.**

**Required Textbook:**
*Materials Kinetics Fundamentals: Principles, Processes, and Applications*, Ryan O'Hare, John Wiley and Sons Inc., 2015

**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:

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| Midterm I (March 3) | - | 35% |
| Midterm II (April 7) | - | 30% |
| Final exam (TBD) | - | 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

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| **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 | Self, tracer, intrinsic and interdiffusion coefficients | 1 lecture |
| 8 | Atomistic models of diffusion | 1 lecture |
| 9 | Diffusion in ionic crystals | 1 lecture |
| 10 | Gas phase diffusion, multipath diffusion | 1 lecture |
| **III** | **KINETICS OF CHEMICAL REACTIONS** | | |
| 11 | Chemical reactions, order of reactions, activation theory | 1 lecture |
| 12 | Gas/solid, gas/liquid kinetic processes | 1 lecture |
| 13 | Mixed rate control: etching, CVD | 1 lecture |
| **IV** | **ROLE OF KINETICS ON MICROSTRUCTURE** | | |
| 14 | Capillarity forces on surfaces, grain growth | 1 lecture |
| 15 | Surface energy anisotropy | 1 lecture |
| 16 | Particle coarsening, sintering | 1 lecture |
| **V** | **KINETICS OF PHASE TRANSFORMATIONS** | | |
| 17 | Homogeneous and heterogeneous nucleation, growth | 1 lecture |
| 18 | Combined nucleation and growth | 1 lecture |
| 19 | Solidification | 1 lecture |
| 20 | Spinodal decomposition | 1 lecture |