

Spring 2024

## MTSE 655 - 102: Difussion and Solid State Kinetics

Andres Jerez

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**COURSE OUTLINE**

**MTSE 655-102**

**(CRN: 14655)**

**Spring 2024**

**DIFFUSION AND SOLID-STATE KINETICS**

**Instructor:** Andres Jerez: [jerez@njit.edu](mailto:jerez@njit.edu)  
(When writing, please include course and section in the subject: MTSE 655 102)

**Lectures:** Mondays 6:00 PM – 8:50 PM, FMH 403

**Office hours:** Mondays and Wednesdays, 1:00 PM – 1:50 PM, TIER 455, and by appointment.

**Textbook:** R. W. Balluffi, S. M. Allen, W. C. Carter, **KINETICS OF MATERIALS**,  
Wiley, 2005, ISBN-13: 978-0471246893

**Course Website:** <http://canvas.njit.edu/>

**Course Description:**

This course presents a unified treatment of phenomenological and atomistic kinetic processes in materials. It provides the foundation for the advanced understanding of processing, microstructural evolution, and behavior for a broad spectrum of materials. The course emphasizes analysis and development of rigorous comprehension of fundamentals. Topics include irreversible thermodynamics; diffusion; nucleation; phase transformations; fluid and heat transport; morphological instabilities; gas-solid, liquid-solid, and solid-solid reactions.

**Learning Outcomes:**

As diffusion is one of the fundamental mechanisms in the processing of materials, from steel to semiconductor devices, students taking this course will become familiar with both the macroscopic and the atomic description of diffusion. They will learn how to characterize diffusion phenomena in dilute alloys as well as in ionic and covalent solids. High atom mobility effects at defect sites and surfaces are examined. Chemical kinetics and kinetics of phase transformations including nucleation, growth, and spinoidal decomposition are discussed.

**Final Grade:**

Midterm Exam:	30%
Final Exam:	30%
Homework:	20%
Presentation:	20% (Presentation and report-details will be discussed in class)

**Grade Scale:**

A: 85% and more;  
B+: 75% - 84%;  
B: 65% - 74%;  
C: 55% - 64%;  
D: 50% - 54%;  
F: 49% and less

**Schedule:**

<b>Date:</b>	<b>Subject (textbook chapter):</b>
01/22	Introduction (Ch. 1), Irreversible Thermodynamics (Ch. 2)
01/29	Driving Forces and Fluxes for Diffusion (Ch. 3)
02/05	The Diffusion Equation (Ch. 4)
02/12	Solving the Diffusion Equation (Ch. 5-6)
02/19	Atomic Models for Diffusion (Ch. 7)
02/26	Diffusion in Crystals (Ch. 8)
03/04	<i>Midterm Exam (Ch. 1-8)</i>
03/11	<i>Spring Break</i>
03/18	Diffusion along Crystal Imperfections (Ch. 9)
03/25	Diffusion in Non-crystalline Materials (Ch. 10)
04/01	Particle Coarsening, Grain Growth, Diffusional Creep and Sintering (Ch. 14-16)
04/08	Phase Transitions, Spinodal and Order-Disorder Transitions (Ch. 17-18)
04/15	Nucleation (Ch. 19)
04/22	Diffusional Growth, (Ch. 20-21)
04/29	Presentations
05/06	<i>Final Exam</i>

***FIRST DAY OF CLASSES: Tuesday, January 16***

***LAST DAY TO WITHDRAW: Monday, April 1***

***SPRING BREAK: March 11 – March 17***

***Friday Classes Meet: Tuesday, April 30***

***LAST DAY OF CLASSES: Tuesday, April 30***

***READING DAY2: May 1-2***

***FINAL EXAM PERIOD: May 3 – May 9***

***FINAL GRADES DUE: May 11***