



THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Transformation and Processing of Materials

MATSCEN 3141

Credit Hours:

3.00

Course Levels:

Undergraduate (1000-5000 level)

Graduate (5000-8000 level)

Course Components:

Lecture

Course Description:

Introduction to transformations, and the relationship between microstructure, properties, and processing in metals, ceramics, semiconductors, and polymers.

Prerequisites and Co-requisites:

Prereq: 2251, and enrollment as MatScEn-BS or WeldEng-BS major; or permission of instructor.

Course Goals / Objectives:

- Provide students with a detailed understanding of the phenomena, principles, and mechanisms that govern transformations in materials
 - Apply the basic concepts of thermodynamics and kinetics in determining the driving forces and mechanisms of microstructural transformations
 - Understand the basic kinetics and morphology of nucleation and growth processes in solids
 - Apply the concepts of transformation kinetics to the understanding and control of microstructure-property relationships in materials
 - Find, interpret, and use materials properties in computational models of transformation kinetics
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Course Topics:

- Introduction to transformations – microstructures and mechanisms
 - Thermodynamics and phase diagrams - chemical potential, binary free energy and phase diagrams
 - Phase diagrams and their relationship to kinetics of transformations
 - The nature and types of equilibrium, and the driving force for a reaction
 - Basics of diffusion – atomic mechanisms, Fick's laws
 - Surfaces, interfaces and microstructure – interfacial energy and shape, the nature of interfaces, Gibbs-Thompson equation
 - Solidification and microstructure – homogeneous and heterogeneous nucleation and growth kinetics of solids from liquids
 - Diffusional transformations in solids – nucleation, growth, and precipitation in solid-solid systems
 - Processing of defective microstructures – crystallization of amorphous solids, recrystallization, sintering of powders
 - Precipitation kinetics – Avrami equation, TTT and CCT curves
 - Diffusionless transformations – the martensite transformation
 - Decomposition of martensite, and the shape memory effect
 - Gas-solid reactions – CVD and PVD, epitaxial growth and oxidation kinetics
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Designation:

Required