

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

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

Designation:

Required