MATSCEN 3141 (Approved): Transfomation and Processing of Materials

Course Description

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

Prior Course Number: MSE543
Transcript Abbreviation: Trans Proc Mats
Grading Plan: Letter Grade
Course Deliveries: Classroom, Less than 50% at a distance
Course Levels: Undergrad, Graduate, Dentistry, Medicine
Student Ranks: Junior
Course Offerings: Spring
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Lec
Expected out-of-class hours per week: 6.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: MSE 2251, MSE 2241 (or equivalent), or permission of instructor
Exclusions: Not open to graduate students in MSE or WE
Cross-Listings:

The course is required for this unit's degrees, majors, and/or minors: Yes
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: No

Subject/CIP Code: 14.3101
Subsidy Level: Baccalaureate Course

Programs

Abbreviation	Description
MATSCEN	Materials Science and Engineering

Course Goals

To provide students with a detailed understanding of the phenomena, principles, and mechanisms that govern transformations in materials.
To be able to apply the basic concepts of thermodynamics and kinetics in determining the driving forces and mechanisms of microstructural transformations.
To understand the basic kinetics and morphology of nucleation and growth processes in solids.
To be able to apply the concepts of transformation kinetics to the understanding and control of microstructure-property relationships in materials.

To be able to find, interpret, and use materials properties in computational models of transformation kinetics.

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Introduction to transformations microstructures and mechanisms	3.0	3.0						
Thermodynamics and phase diagrams - chemical potential, binary free energy and phase diagrams	3.0	3.0						
Phase diagrams and their relationship to kinetics of transformations	6.0	6.0						
The nature and types of equilibrium, and the driving force for a reaction	3.0	3.0						
Basics of diffusion atomic mechanisms, Ficks laws	3.0	3.0						
Surfaces, interfaces and microstructure interfacial energy and shape, the nature of interfaces, Gibbs-Thompson equation	3.0	3.0						
Solidification and microstructure homogeneous and heterogeneous nucleation and growth kinetics of solids from liquids	3.0	3.0						
Diffusional transformations in solids nucleation, growth, and precipitation in solid-solid systems	3.0	3.0						
Processing of defective microstructures crystallization of amorphous solids, recrystallization, sintering of powders	3.0	3.0						
Precipitation kinetics Avrami equation, TTT and CCT curves	3.0	3.0						
Diffusionless transformations the martensite transformation	3.0	3.0						
Decomposition of martensite, and the shape memory effect	1.0	1.0						
Gas-solid reactions CVD and PVD, epitaxial growth and oxidation kinetics	2.0	2.0						

Representative Assignments

Reading assignments and homework problems are assigned from the textbook, and from additional sources.

Grades

Aspect	Percent
Mid-term examinations (2) @ 22.5% of grade total each	45%
Final examination	45%
Homeworks and class participation	10%

Representative Textbooks and Other Course Materials

Title	Author
Phase Transformations in Metals and Alloys	D. A. Porter, K. E. Easterling, and M. A. Sharif

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
**	a	An ability to apply knowledge of mathematics, science, and engineering.

Course Contribution		College Outcome
*	b	An ability to design and conduct experiments, as well as to analyze and interpret data.
*	c	An ability to design a system, component, or process to meet desired needs.
***	d	An ability to function on multi-disciplinary teams.
***	e	An ability to identify, formulate, and solve engineering problems.
*	f	An understanding of professional and ethical responsibility.
*	g	An ability to communicate effectively.
**	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
*	i	A recognition of the need for, and an ability to engage in life-long learning.
**	j	A knowledge of contemporary issues.
***	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Prepared by: William Clark