

## **MSE-221 Materials Thermodynamics & Kinetics**

**Credit Hours:** 3-0

**Pre-requisites:** None

### **Course Objectives**

- To introduce fundamental concepts in thermodynamics of material systems
- To describe laws of thermodynamics that govern any changes in the state of a system
- To develop an understanding of how different certain variables lead a system to an equilibrium state
- To differentiate between macroscopic and microscopic equilibrium states
- To discuss different types of equilibria including those involving chemical reactions
- Laws of Thermodynamics
- Chemical and electrochemical equilibria
- Thermodynamic treatment of materials
- Kinetics aspects like diffusion, phase transformation and microstructure development

### **Course Contents**

- Treatment of the laws of thermodynamics and their applications to equilibrium and the properties of materials
- General phenomena in materials science and engineering, including chemical reactions, magnetism, polarizability, and elasticity
- Relations pertaining to multiphase equilibria as determined by a treatment of solution thermodynamics
- Graphical constructions essential for the interpretation of phase diagrams
- Treatment includes electrochemical equilibria and surface thermodynamics
- Aspects of statistical thermodynamics related to macroscopic equilibrium phenomena
- The kinetics aspect includes diffusion, phase transformations, and the development of microstructure

## Course Outcome

By the end of this course, the student is expected to:

- An ability to apply and couple the basic concepts of thermodynamics, diffusion, and crystallography
- Ability to Solve real time engineering problems related to microstructure evolution and microstructure-property relationships
- An ability to function on multi-disciplinary teams
- To gain knowledge of contemporary issues.
- clearly define and interpret various laws of thermodynamics
- comprehend the role of thermodynamics in solid-phase material systems
- be able to predict any change(s) in the state of a system given few parameters
- demonstrate the ability to describe unary-, binary-, and two-phase systems

## Suggested Books

- David V Ragone, *Materials Thermodynamics, Volume 1 of MIT series on Materials Science & Engineering.*
- Gaskell, David R. *Introduction to Metallurgical Thermodynamics*, 1981: Hemisphere Pub. Corp.
- James E. House, *Principles of Chemical Kinetics, 2<sup>nd</sup> Edition, Academic Press, 2007.*