

MSE-222 Phase Transformation and Equilibria

Credit Hours: 3-0

Pre-requisites: MSE-221 Materials Thermodynamics & Kinetics

Course Objectives

The course offers insight into the important field of phase transformations in metals and alloys. The specific course objectives are:

- Underlying thermodynamics, Gibb's Free energy
- Binary solutions, Phase diagrams and heterogeneous systems
- Diffusion, Types of transport, atomic mobility, carburization of steel
- Crystal interfaces/microstructure, Grain boundary migration/mechanics, types of interfaces
- Solidification, Nucleation and growth
- Diffusional and non-diffusional transformations in solids.

Course Contents

- Thermodynamics and Phase Diagrams
- Binary solutions
- Binary Phase Diagrams
- Equilibrium in Heterogeneous systems
- Ternary equilibrium
- Diffusion
- Crystal Interfaces and Microstructures
- Special High Angle grain boundaries
- Phase coherence, second phase interface energy, solidification and heat flow
- Eutectic solidification
- Diffusional transformation in solids, eutectoid transformations
- GP zones, Diffusion less transformations
- Martensitic transformation, glass transformation, spinodal decomposition

Course Outcome

At the end of the course the students are expected to have learned the following:

- Phase transformations & associated thermodynamics
- Variables influencing development of a particular microstructure in alloys
- Structure-property relationships in view of the fabrication process route

Suggested Books

- David A. Porter and Kenneth E. Easterling, *Phase Transformations in Metals and Alloys, Third Edition (Revised Reprint) CRC Press.*
- Hats Hilleret, *Phase Equilibria, Phase Diagrams and Phase Transformations: Their Thermodynamic Basis, Cambridge University Press 8th Edition 2008.*