MSE-325 Heat Treatment of Materials (3 CH)

Pre-requisites: MSE-222 (Phase Transformation and Equilibria)

Course Objectives

- To explain different equilibrium and non-equilibrium phase transformations
- To familiarize with different heat treatment processes carried out to improve surface and bulk properties.

Course Contents

3. Introduction and applications of Iron-carbide (I-C) diagram and TTT diagrams, Process of heat treatment, Annealing, Normalizing, Hardening, Tempering, Case Hardening (Carburizing, Nitriding, Carbonitriding), Surface Hardening (Flame hardening, Induction hardening, Laser hardening), Thermo-mechanical treatment of steels (Ausforming, Isoforming, Cryoforming), Heat treatment of stainless steels and cast irons, Al alloys, Cu alloys, Ti alloys.

COURSE OUTCOMES:

4. The student should be able to,
    a. Describe different phases formed/found in steels, understand mechanisms governing their formation and explain effect of alloying additions on kinetics of phase transformation.

    b. Demonstrate a comprehensive understanding of bulk heat treatment processes and be able to apply these treatments for microstructure optimization in order to induce desired mechanical properties for specific industrial application.

    c. Explain surface hardening and case hardening methods and be able to apply them to obtain desired surface properties. In addition, the student should also be able to apply different case depth measurement methods.

d. Comprehend relationships between different thermo-mechanical treatments and apply them to engineer microstructure and mechanical properties.

e. Predict and evaluate appropriate heat treatment cycles to induce suitable mechanical properties in stainless steels, tools steels, maraging steels and powder metallurgy parts.

Suggested Books

1. George Krauss, Steels: Processing, Structure, and Performance (Principles of heat treatment of steels), 2nd Edition, ASM International, (2015)
2. G.M. Russel,J.L. Smith,S.C. Bhatia, Heat Treatment Of Metals, Volume – 1, CBS Publishers & Distributors Pvt. Ltd, (2012)
3. George E. Totten, Steel Heat Treatment: Metallurgy and Technologies, 2nd Edition, Press CRC, (2006)
4. Vijendra Singh, Heat Treatment of Metals, 2nd Edition, Standard Publishers Distributors, (2006)