

B. Tech (Metallurgical & Materials) Syllabus from Admission Batch 2018-19
5th Semester

5th Semester	RMM5C002	Phase Transformation and Heat Treatment of Materials	L-T-P 3-0-0	3 Credits
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Objectives of the course

To introduce the student to key concepts in Phase transformations and Heat treatments and enable an understanding of the steps involved in several important phase transformations and heat treatment of different materials.

Module I:

(6 hours)

Introduction: Definition and types of Phase transformations, Free Energy for Ideal solution and regular solution, Free energy Composition diagrams, Pseudo eutectic phase diagram and congruent melting, Miscibility gap; Ternary Phase Diagram.

Module II:

(6 hours)

Order-disorder Transformation Examples of ordered structures, long and short range order, detection of super lattices, influence of ordering on properties.
Crystal interfaces and microstructure. Microstructure evolution including recrystallization and grain growth.

Module III:

(8 hours)

Review of Iron-carbon alloy system: Phase rule and phase diagram, Iron-cementite and iron-graphite phase diagrams, cooling of hypo-eutectoid, eutectoid and hyper-eutectoid steels, hypo-eutectic, eutectic and hyper-eutectic cast irons, Graphitisation; Nucleation and growth of pearlite. mechanisms of age hardening, examples from Al-Cu and other alloy systems

Module IV:

(12 hours)

Importance of Austenite Grain size. Formation of Austenite, Eutectic, Pearlitic, Bainitic and Martensitic Transformations (Mechanisms, Kinetics and Morphologies).
Pearlitic transformation, Factors influencing pearlitic transformation, Mechanism of transformation, Nucleation and growth, Orientation relationship. Bainitic transformation: Mechanism of transformation, Nucleation and growth, Orientation relationship. Martensitic transformation: Characteristics of transformation, Thermodynamics and kinetics, Nucleation and growth, Morphology, Crystallography, Stabilization. Spinodal decomposition

Module V:

(8 hours)

Heat treatment of steels: TTT and CCT diagrams, conventional heat treatment processes – annealing, normalizing, hardening and tempering. Hardenability, role of alloying elements in steels. Surface hardening and chemical treatment in steels;
Heat treatment of some Cu, Al and Ti based alloys.

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Books:

- [1] Phase Transformations in Metals and Alloys by D. A. Porter and K. E. Easterling, CRC Press.
- [2] Phase Transformations in Materials by R. C. Sharma
- [3] Solid State Phase Transformations by Raghavan, PHI
- [4] Heat Treatment by Rajan and Sharma, PHI.
- [5] Physical Metallurgy Principles by R. E. Reed-Hill, East West Press

Digital Learning Resources:

Course Name:	Phase Transformation and Heat Treatment
CourseLink:	https://nptel.ac.in/courses/113/101/113101003
Course Instructor:	Dr.M.P.Gururajan, IIT,Bombay