NOC:Phase Diagrams in Materials Science and Engineering - Video course

COURSE OUTLINE

Phase diagrams are important for materials science and engineering applications encompassing from structural materials to functional materials, including electronic, magnetic applications. The course is intended to make the students and research familiarize with binary and ternary phase diagrams and microstructure of different materials. It is to be noted that microstructure plays a vital role in deciding the properties of the materials. Thus, it is important to connect the phase diagram information for microstructural evolution.

COURSE DETAIL

Week .No	Topic
1	Lecture 1: Phase rule, lever rule, Free energy of phase mixture Lecture 2 : Unary systems, Effect of pressure on phase diagrams Lecture 3: Binary Isomorophous Systems, Free energy-composition digrams,
2	Lecture 4 : Equilibrium solidification, Non- Equilibrium solidification of alloys, Lecture 5: Coring, examples from Cu-Ni alloys, Zone refining Lecture 6: Phase Diagrams of Binary Eutectic systems
3	Lecture 7: Solidification of eutectic, hypo-eutectic, and hyper-eutectic alloys and their morphologies with examples from Al-Si, Fe-C, Ag-Cu, Pb-Sn systems Lecture 8: Phase diagrams of binary peritectic System, evolution of these phase diagrams Lecture 9 : Solidification of peritectic alloys,
4	Lecture 10 : hypo and hyper-peritectic alloys; Morphologies Lecture 11: Concept of Liquid Phase immiscibility Binary Monotectic and Systectic Systems Lecture 12: Evolution of monotectic and syntactic phase diagrams, free –energy composition diagrams,
5	Lecture 13: Development of microstructures in systems Cu-Pb, Na-Zn, K-Zn, Effect of gravity on solidification of these alloys Lecture 14: Concept of solid state immicibility and spinodal decompositions, Lecture 15: Phase diagrams showing spinodal decomposition, microstrucural evolution
6	Lecture 16: Thermodynamics of phase equilibria: Regular and irregular solutions Lecture 17: Models for regular and irregular solutions, Lecture 18: Quasichemical theory : detailed descriptions
7	Lecture 19 : Stability of regular solution and miscibility gap, Lecture 20- 21: Application of Quaichemical to eutectic, peritectic Lecture 22 : and Monotectic systems, intrinsic stability of solution and spinodal.
8	Lecture 23: Theory of alloy Phases: Hume-Rothery rules, Lecture 24 : Intermediate phases e.g., laves, sigma, electron compounds Lecture 25: Important systems with intermediate phases: Ni-Al, Ti-Al and Fe-Al systems

NP-TEL

NPTEL

http://nptel.ac.in

Metallurgy and Material Science

Pre-requisites:

Metallurgical Thermodynamics and knowledge of using computer softwares

Coordinators:

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9	Lecture 26 : Iron-carbon phase diagram and microstructures of plain carbon steel and cast iron: non-equilibrium structures Lecture 27-28::Some binary ceramics systems: SiO_2-Al_2O_3, NiO-MnO, etc and their microstructure.
10	Lecture 29 : Ternary phase diagrams: Gibbs triangle, isothermal and vertical sections, Lecture 30-31: Polythermal projections, two-phase equilibrium
11	Lecture 32: Concept of the lines, rules for construction of tie lines, Lecture 33-34: three phase equilibrium, concept of tie-triangle, four phase equilibria.
12	Lecture 35-36: Multi-component alloy systems: Stainless steels, high speed steels, super alloys, light metal alloys, refractory systems (Al_2O_3 - SiO_2 - MgO)