

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E Semester: 3 Metallurgy Engineering

Subject Code 132102

Subject Name Metallurgical Thermodynamics

Sr.No	Course content
1.	Importance of thermodynamics, Definition of thermodynamic terms, Concept of system, states and equilibrium, Types of system, Extensive and intensive properties, Homogeneous and heterogeneous systems, Quasi-static process, Zeroth law of thermodynamics.
2.	First law of thermodynamics, Internal energy, Heat capacity, Specific heat and latent heat, Enthalpy, Isothermal and adiabatic processes, State properties, Heat of reaction, Heat of formation, Standard heats, Heat of transition, Hess's law, Kirchoff's law equation.
3.	Second law of thermodynamics, Entropy of irreversible processes, Auxiliary functions, Combined statements of 1 st and 2 nd laws, Maxwell's relations, Clausius-Clapeyron equation, Gibb's-Helmholtz relations.
4.	Third law of thermodynamics, Temperature dependence of entropy, Stastical interpretation of entropy, Relation between C_p and C_v , Consequences of third law, Nernst heat theorem, Equilibrium constant, Van-Hoff equation, Concept of fugacity, activity and mole fraction.
5.	Ellingham diagram in detail for metal oxides, Activity, Gas phase reactions (H_2O - H_2 and CO_2 - CO mixtures), Reactions involving solid and gases, Activities in concentrated solution, Activity in industrial liquid metallic solution.
6.	Thermodynamics of solutions, Gibb's-Duhem equation, Partial molar properties of mixing, Ideal solution, Raoult's law, Henry's law, Non-ideal solution, Excess functions, Concept of 1 wt% standard state and Interaction coefficient, Regular solutions, Sievert's law-residual gases in steel.
7.	Phase relations and phase rule-its applications, Free energy-composition and temperature-composition diagrams for binary alloy systems and their correlation, determination of liquidus, solidus and solvus lines, Effect of pressure on phase transformation and phase equilibria.

8.	Functions of slags, Slag compositions, Structure of molten slags, Molecular theory, Concept of basicity index, Thermodynamics of slag-metal reactions.
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Term Work: Numerical problems based on the concepts mentioned in above units.

Reference Books:

- 1) Introduction to Metallurgical Thermodynamics, R. H. Tupkary, T. U. Publishers.
- 2) Introduction to Materials and Metallurgical Thermodynamics, A. Ghosh, PHI.
- 3) Physical Chemistry of Metals, L. S. Darken and R. W. Gurry, McGraw Hill.
- 4) Problems in Metallurgical Thermodynamics and Kinetics, G. S. Upadhyaya and R. K. Dube, Pergamon Press.