

**PHYSICAL: PHASE EQUILIBRIA & BINARY SOLUTIONS****THEORY****Unit I: Phase equilibria**

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems (water, sulphur, carbon dioxide), with applications.

Phase diagrams for two component systems involving eutectic, congruent and incongruent melting points and solid solutions.

Three component system: water-chloroform-acetic acid system only.

**Unit: II: Binary Solutions**

Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes, lever rule, partial miscibility of liquids, CST, immiscible pairs, steam distillation. Nernst distribution law: its derivation and applications.

**Unit III: Solid state:**

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Glasses and liquid crystals.

**Recommended texts:**

1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry 8<sup>th</sup> Ed.*, Oxford University Press 2006.
2. Ball, D. W. *Physical Chemistry* Cengage India 2012.
3. Castellan, G. W. *Physical Chemistry 4<sup>th</sup> Ed.*, Narosa 2004.
4. Mortimer, R. G. *Physical Chemistry 3<sup>rd</sup> Ed.*, Elsevier: NOIDA, UP 2009.
5. Levine, I. N. *Physical Chemistry 6<sup>th</sup> Ed.*, Tata McGraw-Hill 2011.
6. Metz, C. R. *Physical Chemistry 2<sup>nd</sup> Ed.*, Tata McGraw-Hill 2009.

**PRACTICAL****PHYSICAL: DETERMINATION OF CRITICAL SOLUTION AND PHASE EQUILIBRIA**

- I. Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.

- II. Phase equilibria: Construction of the phase diagram using cooling curves or ignition tube method:
  - a. simple eutectic and
  - b. congruently melting systems.
- III. Indexing of a given powder diffraction pattern of a cubic crystalline system.
- IV. Distribution of acetic/ benzoic acid between water and cyclohexane.

**Recommended Texts:**

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi 2011.
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8<sup>th</sup> Ed.*; McGraw-Hill: New York 2003.
3. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3<sup>rd</sup> Ed.*; W.H. Freeman & Co.: New York 2003.
4. Sindhu, P.S. *Practicals in Physical Chemistry 1<sup>st</sup> Ed.* Macmillan: India 2006.