- Batra, S.K., Kapoor, V and Gulati, S. (2017) 1 st Edition, Experiments in Physical Chemistry, Book Age series.

Teaching Learning Process:

- Conventional chalk and board teaching,
- Class interactions and discussions
- Power point presentation on important topics.

Assessment Methods:

- Class Tests at Periodic Intervals.
- Written assignment (s) / Presentation by individual students
- End semester University Theory and Practical Examination

Keywords: Rate law, Order of reaction, Activation Energy, Conductance, Transference Number, Electrode potential, Electrochemical series.

11.2.9. Course Code: CHEMISTRY (DSE-C3)
Course Title: PHASE EQUILIBRIUM AND SOLUTIONS
Total Credits: 04 (Credits: Theory-02, Practical-02)
(Total Lectures: Theory- 30, Practical-60)

Objectives: The students will gain an understanding of phase, co- existence of phases, phase diagram, CST and distribution law and its applications.

Learning Outcomes:
By the end of this course, students will be able to:

- Understand phase equilibrium, criteria, CST, Gibbs-Duhem-Margules equation.
- Apply the concepts of phase and its applications in purification etc.
- Learn about distribution law and its importance in solvent extraction.

Unit 1: 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 (H_2O, CO_2 and S), with applications. Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points. Phase diagram of three component system, Triangular plots, water-chloroform-acetic acid system.
Application of phase in explaining phenomenon in everyday life.

(Lectures: 15)

Unit 2: Solution

Concentration term, lowering of vapour pressure, Raoult's law. Thermodynamic basis of the colligative properties - lowering of vapour pressure, elevation of Boiling Point, Depression of Freezing point and Osmotic pressure and derivation of expressions for these using chemical potential. Concept of activity and activity coefficients. Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and non-ideal), azeotropes, lever rule, partial miscibility of liquids, CST (both upper and lower) and effect of impurities on CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications.

(Lectures: 15)

PRACTICALS (Credits: 02; Laboratory Periods:60)

Phase Equilibrium

1. Determination of critical solution temperature and composition at CST of the phenol water system
2. To study the effect of impurities of sodium chloride and succinic acid on the CST of phenol-water system.
3. Construction of the phase diagram using cooling curves :
   (i) simple eutectic
   (ii) congruently melting systems.
4. Distribution of I_2/acetic/ benzoic acid between water and chloroform/CCl_4 or cyclohexane.
5. Study of equilibrium of any one of the following reactions by distribution method:

(i) $I_2\ (aq) + I^-\ (aq) \rightleftharpoons I_3^-(aq)$

(ii) $Cu^{2+}\ (aq) + nNH_3 \rightleftharpoons [Cu(NH_3)_n]^{2+}$

REFERENCES:

Theory:

- Atkins, P.W.; Paula, J.de. (2014), Atkin's Physical Chemistry Ed., 10th Edition, Oxford University Press.
- Ball, D. W. (2017), Physical Chemistry, 2 nd Edition, Cengage Learning, India.
- Castellan, G. W. (2004), Physical Chemistry, 4 th Edition, Narosa.
- Kapoor, K.L. (2015), A Textbook of Physical Chemistry, Vol 1, 6 th Edition, McGraw Hill Education.
- Kapoor, K.L. (2020) A Textbook of Physical Chemistry, Vol 3, 5th Edition, McGraw Hill Education.

Practical:

- Khosla, B.D.; Garg, V.C.; Gulati, A. (2015), Senior Practical Physical Chemistry, R. Chand & amp; Co, New Delhi.
- Kapoor, K.L. (2019), A Textbook of Physical Chemistry, Vol.7, 1 st Edition, McGraw Hill Education.
- Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. (2003), Experiments in Physical Chemistry, 8 th Edition, McGraw-Hill, New York

Additional Resources:

- Moore, W.J. (1972), Physical Chemistry, 5th Edition, Longmans Green & Co. Ltd.
- Glasstone, S. (1948), Textbook of Physical Chemistry, D. Van Nostrand company, New York.

Teaching Learning Process:

- Conventional chalk and board teaching,
- Class interactions and discussions
- Power point presentation on important topics.

Assessment Methods:

- Class Tests at Periodic Intervals.
- Written assignment (s) / Presentation by individual students
- End semester University Theory and Practical Examination

Keywords: Phase rule, One-component system, Eutectic, Congruent, Incongruent, Raoult's, law, Gibbs-Duhem-Margules, Critical solution temperature.

11.2.10. Course Code: CHEMISTRY (DSE-C4)
Course Title: NOVEL INORGANIC SOLIDS
Total Credits: 04 (Credits: Theory-03, Practical-01)
(Total Lectures: Theory- 45, Practical-30)

Objectives: Solid-state chemistry also referred as material chemistry currently has emerged with great focus on novel inorganic solids. It has found enormous applications in both industrial and research arenas and has helped to shape modern day recyclable adsorbents and catalysts. Novel inorganic-organic hybrid nanocomposites have received a lot of attention because of their abundance and cost-effective nature they can be utilized as catalysts, as a nano reactor to host reactants for synthesis and for the controlled release of biomolecules. Materials such as metals, composites, nanomaterials make life easier in this era and are great sources of industrial advancement and technological changes. Therefore, its exposure to the undergraduates with science backgrounds can groom them for future research.

Learning Outcomes:
By the end of this course, students will be able to:

- Understand the mechanism of solid-state synthesis.
- Explain about the different characterization techniques and their principles.
- Understand the concept of nanomaterials, their synthesis and properties.
- Explain the mechanism of growth of self-assembled nanostructures.
- Understand the real-world importance of bioinorganic nanomaterials.
- Explain the importance of composites and their applications.
- Understand the importance and real-life application of solid materials