Basics of Physical Chemistry-I

Course Code:BEB506 **Credit: 04 (L-3, T-1, P-0)**
Contact Hours: 60 **MM: 100**

After going through the course the teacher trainee will be able to –

- master a broad knowledge in the field of physical chemistry which he will later apply to other topics in higher levels.
- apply their knowledge of Kinetic theory of gases in the explanation of deviations of real gases behavior from ideality.
- describe the various properties of the substances in gaseous, liquid and solid state.
- apply their theoretical knowledge in the explanation of the properties and also demonstrate it practically through experiments.
- explain the principal laws of thermodynamics and how these dictate the behavior of chemical substances and the difference between various forms of energy.
- understand the objective of their chemical experiments, properly carry out the experiments, and appropriately record and analyze the results

Course Outline:

Unit I: Gaseous state

- Kinetic molecular theory of gases: postulates, kinetic gas equation; derivation of gas laws.
- Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy,
- Collision diameter; collision frequency; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity.
- Deviations from ideal gas behaviour, Causes of deviation from ideal behaviour, compressibility factor (Z), Effect of temperature on deviations.
- Van der Waals equation of state, its derivation and application in explaining real gas behaviour, continuity of states, Joule Thomson effect.

Unit II: Liquid state

- Physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity and their determination.
- Temperature variation of viscosity of liquids and comparison with that of gases.
- pH scale, common ion effect; dissociation constants of mono-, di- and tri- protic acids.
- Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts

Unit III: Ionic equilibria

- Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body.
- Solubility and solubility product of sparingly soluble salts
- Theory of acid – base indicators; selection of indicators and their limitations.

Unit IV: Thermodynamics - I

- Thermodynamic terms, laws of thermodynamics.
- First law:relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.
- Second Law:Concept of entropy; carnot cycle; statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

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Unit V: Thermodynamics - II

- Partial molar quantities, dependence thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.
- Free Energy Functions-Gibbs and Helmholtz energy; variation of *S, G, A* with *T, V, P*; Free energy change and spontaneity
  Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.
- Effect of temperature (Kirchoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.
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- **Suggested Reading:**

- Atkins, P. W. & Paula, J. de, Atkin's Physical Chemistry,8th Ed., Oxford University Press (2006).
- P. C. Rakshit, Physical Chemistry, 5th Ediyion (1988), 4th Reprint (1997), Sarat Book House, Calcutta
- K.J. Laider and J.M. Meiser, 3rd Edition, Houghton Mifflin Comp., New York, International Edition (1999).
- B.R. Puri, L.R. Sharma and M.S. Pathania, 37th Edition (1998), Shoban Lal Nagin Chand & Co., Jalandhar

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