

## Basics of Physical Chemistry-I

**Course Code: BEB506**

**Contact Hours: 60**

**Credit: 04 (L-3, T-1, P-0)**

**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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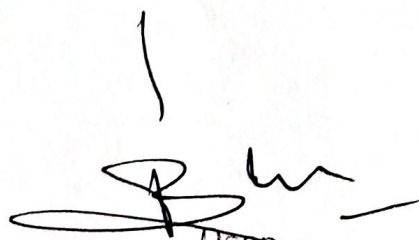


## Unit V: Thermodynamics - II


- 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.

### Suggested Reading:

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



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