MCYC103 Physical Chemistry-I (3-0-0) (3 credits)

Module I (10 hours)

Thermodynamics: A brief survey of laws of thermodynamics.

Standard States for Gases, Liquids and Solids and its Applications. Free Energies, Enthalpies and Entropies of Ions in Solutions. Activity and Mean Activity Coefficients of Electrolytes and their Determinations, Debye-Huckel Limiting Law. Thermodynamics of Mixing–Mixtures of Volatile Liquids– ideal and Real Solutions and Activities-Excess Functions. Thermodynamic Derivations of Phase Rule, Applications to two component (eutectic) and three component systems involving solids and liquids (Acetic Acid – Chloroform - Water, NaCl-Na_2SO_4-H_2O, NH_4NO_3-$(NH_4)_2SO_4$-H_2O.

Module II (8 hours)

Statistical Thermodynamics: The Boltzman equation, most probable configuration and concept of residual entropy. The Boltzman distribution formula.

The concept of partition function, Molecular partition functions: translational, rotational, vibrational and electronic partition functions. Characteristic temperatures, Translational partition function of a mono-atomic gas and derivation of ideal gas equation. Principle of equipartition of energy.

Module III (10 hours)

Electrochemistry-I: Debye Huckel-Onsager equation for the equivalent conductivity of electrolytes – experimental verification of the equation –conductivity at high field and at high frequency –conductivity of non aqueous solutions-effect of ion association on conductivity. The electrode-electrolyte interface-electrical double layer-electro capillary phenomena- Lippmann equation–the Helmholz–Perrin–Guoy-Chapmann and Stern models, Electrokinetic phenomena Tiselius method of separation of proteins - membrane potential.

Module IV (8 hours)

Electrochemistry-II: Elecrodics - Mechanism of electrode reactions-polarization and overpotential –The Butler volmer equation for one step and multistep electron transfer reaction– significance of equilibrium exchange current density and symmetry factor- significance of transfer coefficient-mechanism of the hydrogen evolution reaction and oxygen evolution reactions. Some electrochemical reactions of technological interest-corrosion and passivity of metals-construction and use of Pourbaix and Evans diagrams- methods of protection of metals from corrosion, Fuel cells - electro deposition.

Text Books

1. S. Glasstone, Thermodynamics for Chemists, Affiliated East West Press, 1965.
2. D. A. McQuarrie and J. D. Simon, Physical Chemistry: A Molecular Approach,Viva Student Edition,2015.
3. R. J. Silbey, R. A. Alberty, M. G. Bawendi, Physical Chemistry, Wiley, 4th Edition, 2005.

References

1. J. O. M. Bockris and A. K. N. Reddy, Modern Electrochemistry, Plenum Press, 1970.
2. P.W. Atkins, Physical Chemistry, 8th Edn., Oxford University Press, 1998.
3. J. Rajaram and J. C. Kuriacose, Thermodynamics for Students of Chemistry, Shobanlal Nagin Chand Co, 1986.