  **INSTITUTE OF PHARMACY** 



**Session: January 2014**

**Module Name**: ***BSBT – 106 PHYSICAL CHEMISTRY***

**Class**: BSc. Biotech. (SEMESTER – II)

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**Aims (Module Purpose):** Physical chemistry is the study of the underlying physical principles that govern the properties and behavior of chemical systems. It involves studying of laws of thermodynamics and their applications. They would know the various properties of the solutions under various systems and chemical kinectics i.e. how the rate of reaction is altered and how it influences the stability of a particular reaction.

**Teaching Methods:**Lectures, Viva-voce, Discussions, Test and Presentations

**Syllabus:**

**Unit-I**

Chemical Thermodynamics: State of a system, state variables, thermodynamic equilibrium, thermodynamic properties, intensive and extensive properties, various types of processes.

First law of thermodynamics, internal energy and enthalpy, change in internal energy and change in enthalpy for expansion of real and ideal gases under isothermal and adiabatic conditions for reversible and irreversible processes. Relation between Cp and Cv. Internal energy change and

enthaply change in a chemical process. Hess’s Law of heat summation. Enthaply of formation, enthaply of ionisation and calculation of bond dissociation energies form thermochemical data.

Second law of thermodynamics, entropy and Gibb’s free energy, Carnot’s cycle, Calculation of entropy change for reversible and irreversible processes under isothermal and non-isothermal conditions. Gibbs Hemholtz equation. Third law of thermodyanamics, Nernst heat theorem, calculation of absolute entropies of substances. Thermodynamics of simple mixtures, partial molar quantities and their significance, chemical potential, Gibbs-duhem equation, variation of chemical potential with temperature and pressure, chemical potential in a mixture of ideal gases. Meaning of chemical equilibrium, homogeneous

and heterogeneous equilibrias. Thermodyanamic derivation of law of chemical equilibrium, Van’t Hoff relation, Relation between free energy change and equilibrium constants Kp, Kc and Kf Temperature and pressure dependence of equilibrium constant.

**Unit-II**

Solutions: Definition, types of solutions, vapour pressure of solution and Raoult’s law. Factors influencing the solubility of gas in liquids, Henry’s Law. Ideal solutions, Duhem-margules equation. Distillation of ideal solutions, lever rule, vapour pressure of ideal solutions and non ideal solutions. Distillation of non-ideal solutions. Azeotropes colligative properties, lowering of vapour pressure, depression in freezing point, elevation in boiling point, osmotic pressure. Their common

features and applications. Thermodynamic derivationof elevation in boiling point, depression in freezing point and osmotic pressure. Van’t Hoff factor and its application to calculate degree of association and degree of dissociation. Phase Equilibria:

Definition of phase, component and degree of freedom phase rule and its thermodynamic derivation. Derivation of Clausius-Clapeyron equation and its importance in phase equilibria, phase diagrams of water system, KI water system andlead-silver system.

**Unit-III**

Chemical Kinetics: Rate of reaction, constant factors influencing rateof reaction, order, molecularity, rate equations for 1st order, 2nd order & 3rd order reactions. Methods for determination order of reaction. Half life complex reactions, consecutive reactions, parallel reactions, chain reactions and opposing reactions. Activation energy and calculation from Arhenius equation. Theories of reaction rates collision theory and transition state theory of biomolecular processes. Catalysis, acid base

catalysis, enzyme catalysis including the mechanisms, Michaelis Menten equation for enzyme catalysis.

Electrochemistry Specific conductance, molar conductance and their dependence on electrolyte concentration, Ionic equilibria and conductance, Essential postulates of Debye Huckel theory of strong electrolytes. Mean ionic activity coefficient and ionic strength, Transport number and its relation to ionic conductance and ionic mobility. Conductometric titrations. pH scale. Buffer solutions, salt

hydrolysis, acid-base indicators.

**Module Outline:**

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| **S. No.** | **Topic** | **No. of lectures** |
| **1** | Chemical Thermodynamics: State of a system, state variables, thermodynamic equilibrium, thermodynamic properties, intensive and extensive properties, various types of processes. | **2** |
| **2** | First law of thermodynamics, internal energy and enthalpy. | **1** |
| **3** | Change in internal energy and change in enthalpy for expansion of real and ideal gases under isothermal and adiabatic conditions for reversible processes. | **2** |
| **4** | Change in internal energy and change in enthalpy for expansion of real and ideal gases under isothermal and adiabatic conditions for irreversible processes. | **1** |
| **5** | Relation between Cp and Cv. Internal energy change and enthalpy change in a chemical process. | **1** |
| **6** | Hess’s Law of heat summation | **1** |
|  | Enthalpy of formation, enthalpy of ionisation and calculation of bond dissociation energies from thermochemical data. | **1** |
| **7** | Second law of thermodynamics and entropy | **2** |
| **8** | Gibb’s free energy | **1** |
| **9** | Carnot’s cycle | **1** |
| **10** | Gibbs Hemholtz equation. Third law of thermodyanamics, Nernst heat theorem. | **1** |
| **11** | Thermodynamics of simple mixtures, partial molar quantities and their significance | **1** |
| **12** | Chemical potential, chemical potential in a mixture of ideal gases. | **1** |
| **11** | Solutions**:** Definition, types of solutions, vapour pressure of solution and Raoult’s law. | **1** |
| **12** | Factors influencing the solubility of gas in liquids, Henry’s Law. Ideal solutions, | **2** |
| **13** | Distillation of ideal solutions, Lever rule, vapour pressure of ideal solutions and non ideal solutions. | **2** |
| **14** | Distillation of non-ideal solutions. Azeotropes | **2** |
| **15** | Colligative properties, lowering of vapour pressure, depression in freezing point and osmotic pressure | **2** |
| **16** | Elevation in boiling point, osmotic pressure. Their common features and applications. | **2** |
| **17** | Phase Equilibria: Definition of phase, component and degree of freedom phase rule and its thermodynamic derivation. | **1** |
| **18** | Clausius-Clapeyron equation | **1** |
|  | Phase diagrams of water system | **1** |
| **19** | Phase diagrams : KI-water system. | **1** |
| **20** | Chemical Kinetics:Rate of reaction, constant factors influencing rate of reaction, order, molecularity, rate equations for 1st order, 2nd order & 3rd order reactions. | **3** |
| **21** | Half life, complex reactions, consecutive reactions, parallel reactions, chain reactions and opposing reactions. | **2** |
| **22** | Activation energy and calculation from Arrhenius equation. Theories of reaction rates collision theory and transition state theory of biomolecular processes. | **2** |
| **23** | Catalysis, acid base catalysis, | **1** |
| **24** | Electrochemistry: Specific conductance, molar conductance | **1** |
| **25** | Dependence of specific conductance and molar conductance electrolyte concentration, Ionic equilibria and conductance. | **1** |
| **26** | Essential postulates of Debye Huckel theory of strong  Electrolytes and Transport number | **1** |
| **27** | Conductometric titrations | **1** |
| **28** | pH scale. Buffer solutions, salt hydrolysis. | **1** |
| **29** | Electrochemical Cells:Distinction between electrolytic and electrochemical cells, standard EMF and electrode potential | **1** |
| **30** | Types of electrodes, Reference electrodes, | **1** |
| **31** | Calculations of ΔG, ΔH and ΔS. | **1** |
| **32** | Potentiometer determination of pH and Potentiometer titrations. | **1** |
| **33** | Summary and Conclusions | **1** |
| **34** | Final Revision Test |  |
|  | Total lectures | **49** |

**Modes of Assessment:**

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| --- | --- |
| Viva voce+ Class participation | 10 |
| Class Tests | 5 |
| Class presentations | 5 |
| Mid-semester Examinations | 20 |

**Instruction for students:**

1. *Late submission is not permissible and will attract minimum awards.*
2. *The synopsis must be submitted one week before the presentation.*
3. *75%**attendance is mandatory, below this percentage, student will not be allowed to appear in the examination.*

**Books Recommended**

1. K. L. Chugh and S L Agnish, Kalyani **Physical Chemistry**, Ludhiana, 2007.

2**.** Puri, B.R., Sharma, L.R. and Pathania, M.S. **Principles of Physical Chemistry**.

Shoban Lal Nagin Chand & Co. 1993