RTM NAGPUR UNIVERSITY NAGPUR
SEMISTER PATTERN SYLLABUS
Subject: Chemistry
B.Sc. Sem. II
CH-202 Paper- II (Physical Chemistry)

Unit-I: Thermodynamics   7.5 Hrs

(A) Second law of thermodynamics, need for second law of thermodynamics, statements of second law of thermodynamics, Carnot's cycle and its efficiency, Carnot theorem, thermodynamic scale of temperature, concept of entropy, entropy change in reversible and irreversible processes, entropy change of the universe, entropy changefor an ideal gas with change in P, V and T, entropy change during physical changes,
Free energy functions: work function (A) and Gibb's free energy function (G), variation of work function with T and V, variation of Gibb's free energy with T and P, A and G as criteria for spontaneity and equilibrium of a process, Gibb's-Helmholtz equation and its applications.

(B) Partial molar properties, chemical potential, Gibb's-Duhem equation, Clapeyron equation, Clapeyron-Clausius equation, chemical equilibrium: law of mass action, law of chemical equilibrium, relation between k_p and k_c, Van't- Hoff reaction isotherm, relation between standard free energy change and equilibrium constant, effect of temperature on equilibrium constant, integrated form of Van't Hoff equation.
Numerical problems.

Unit-II: Phase Equilibria and Solutions of Liquids in Liquids   7.5 Hrs

(A) Phase rule, definitions and explanation of the terms: phase, components and degree of freedom, derivation of Gibb's phase rule, application of Phase rule to one component systems (i) water system and (ii) sulphur system, need of reduced phase rule equation, application of Phase rule to two component system: lead-silver system, Pattinson process for de-silverization of lead, Potassium iodide-water system.

(B) Solutions of liquids in liquids, Raoult's law, positive deviation from Raoult's law, negative deviation from Raoult's law, Henry's law, partially miscible liquids: lower and upper consolute temperature (examples of phenol-water, trimethylamine-water system, nicotine-water systems), effect of impurity on consolute temperature, Nernst distribution law, conditions for the validity of the distribution law, Applications of Nernst distribution law: association, dissociation and in the process of extraction,
Numerical problems.

Unit-III: Chemical Kinetics and Theories of Reaction Rates   7.5 Hrs

(A) Rate of reaction, factors affecting the rate of reaction (concentration, temperature, pressure, solvent light and catalyst), order and molecularity of reaction, reactions of zero order, expression of the rate constant for the zero order reaction, derivation of integrated rate equation for first and second order reactions (both for equal and unequal concentration of reactants), characteristics of first and second order reactions, pseudo-unimolecular reactions, methods for determination of order of reactions: integration, differential, graphical, half life period, isolation methods.

(B) Theories of reaction rate: concept of energy of activation, Arrhenius equation, effect of temperature on rate of reaction, collision theory of bimolecular reactions (hard sphere model), transition state theory (equilibrium hypothesis), expression of rate constant based on equilibrium constant and thermodynamic aspects, Lindemann theory of unimolecular reactions.
Numerical problems.

Unit-IV: Nuclear Chemistry and Pollution and its Control   7.5 Hrs

(A) Nuclear chemistry: Radioactivity, stability of nucleus, rate of radioactive decay, mass defect and binding energy, average binding energy, explanation of nuclear stability on the basis of graph between binding energy per nucleon and atomic mass number, Nuclear reactions: fission and fusion, nuclear models: shell model and liquid drop model, comparison between shell model and liquid drop model, Bohr-Wheeler theory, radioisotopes, applications of radioisotopes in medicine, agriculture, industry and Carbon dating.

(B) Pollution and it's control: Introduction, pollution, causes of pollution, segments of environment: lithosphere, hydrosphere, biosphere and atmosphere, composition of atmosphere, atmospheric structure, air pollution, air pollutants like SO_2, SO_3, H_2S, NO, NO_2, CO, CO_2, and O_3, Acid rain, Greenhouse effect/Global warming, Particulates: dust, smoke, fly ash and smog: London smog and photochemical smog, Air pollution control, methods used to control gaseous pollutants: combustion, absorption and adsorption.
Numerical problems.

CH-203: Laboratory Course

Practical - I (Organic Chemistry):
(A) Qualitative Analysis: Element detection(N, Cl, Br, F & S), Identification of functional groups (-COOH, Phenolic –OH, -CHO, Aromatic -NH_2, -$CONH_2$). Determination of M.P & B.P.

(B) Preparation:
(i) Hydrolysis: Preparation of Benzoic acid from Benzamide
(ii) Oxidation: Preparation of Benzoic acid from Benzaldehyde
(iii) Bromination of Phenol.

Practical-II(Physical Chemistry)

1. To determine solubility of benzoic acid at different temperatures and hence determination of heat of solution of benzoic acid.
2. To determine heat of solution of solid calcium chloride and calculate lattice energy of calcium chloride from its enthalpy change data using Born-Haber cycle.
3. To construct phase diagram of three- component system (acetic acid-chloroform-water)
4. To determine critical solution temperature of two partially miscible liquids (phenol-water system).
5. To study the distribution coefficient of iodine between water and carbon- tetra chloride/kerosene.
6. To determine molecular state of benzoic acid in benzene by distribution method.
7. To determine rate constant of hydrolysis of methyl acetate in the presence of acid.
8. To determine the velocity constant of hydrolysis of ethyl acetate by NaOH (Saponification of an ester).

Reference Books (Theory)

1. Barrow G. M; Physical Chemistry, Tata Mc Grow Hills (2007).
2. Castellan G. W; Physical Chemistry, Narosa (2004).
3. Puri B. R; Sharma L. R; Pathania M. S; Principles of Physical Chemistry, Vishal Publishing Company (2018).
4. Gurdeep Raj, Advanced Physical Chemistry, Goel Publishing House (2009).
5. Bajpai D.N; Advanced Physical Chemistry, S. Chand and Compony Ltd. (2001).
6. Atkins P.W, and Paula J. De ; Physical Chemistry, 8th Edn. Oxford University Press (2006).
7. Negi A. S., Anand S. C., A Textbook of Physical Chemistry, New Age International Publishers (2007).
8. Dey A. K., Environmental Chemistry, New Age International Publishers (2019).
9. Dara S.S., A Text Book of Engineering Chemistry, S. Chand and Company Ltd.(2002).

Reference Books (Practical)

1. Das R. C., Behra B., Experimental Physical Chemistry, Tata McGraw Hill.

2. Yadav J. B., Advanced Practical Physical Chemistry, Goel Publishing House.

3. Alexander Findlay, Levitt B. P., Findlay's Practical Physical Chemistry, Longman, London.