DEPARTMENT OF CHEMISTRY
UNIVERSITY OF LUCKNOW
LUCKNOW
Four Year Undergraduate Course Structure
Subject: Chemistry Semester III

Paper	Major Branch	Type	Credits	Total Credits
Paper 5 (P5)	Physical Chemistry 2	Theory	4	4
Paper 6 (P6)	Chemistry Practical 2	Practical	4	4
CC 2	Co-Curriculum	NCC/NSS/Soft skill Development	4	4
Paper 5 (P3")	Physical Chemistry 2	Minor Theory	4	4
P5'	Second major subject	Theory	4	4
P6'	second major subject	Theory	4	4
	Total Credits			**24**

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Subject: Chemistry Semester III

Physical Chemistry 2 (Major P5 and Minor P3")

Semester III **Paper 5** **Credits 4**

Course outcome

CO-1- After the completion of the semester, student will acquire knowledge of first law and second law of thermodynamics, thermochemistry, entropy enthalpy etc.

CO-2- It will also make them familiar with conductance, equivalent conductance, Kohlrausch's law, Ostwald dilution law, Deby-Huckel Onsagar equation, e.m.f. of cell, types of cell, liquid junction potential, pH and pka, Henderson- Hazel equation etc.

Unit I

I. Thermodynamics-1

a. Definition of thermodynamic terms: System, surroundings etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work.

b. First Law of Thermodynamics: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law - Joule-Thomson coefficient and inversion temperature. Calculation of w,q, dU&dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

II. Thermochemistry: Standard state, standard enthalpy of formation - Hess's Law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy,effect of temperature on enthalpy of reaction, Kirchhoff s equation.

Unit II

III. Thermodynamics - II

a. Second law of thermodynamics: statements of second law of thermodynamics, Carnot's cycle and its efficiency, Carnot's theorem. Thermodynamic scale of temperature, Le Chatelier's principle, reaction isotherm and reaction isochore, Clapeyron-Clausius equation and its applications

b. Concept of entropy: Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, criteria of spontaneity and equilibrium change in ideal gases and mixing of gases.

IV. Gibbs and Helmholtz free energy functions and their definitions

Unit III

V. Electrochemistry -1:

a. Electrical transport - Conduction in metals and in electrolyte solutions, specific conductance, equivalent conductance, experimental determination of equivalent conductance and specific conductance, variation of equivalent and specific conductance with dilution. Kohlrausch's law, weak and strong electrolyte, Arrhenius theory of electrolyte dissociation and its limitations. Ostwald's dilution law its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and its determination by Hittorfs method and moving boundary method.

VI. Applications of conductivity measurements: Determination of degree of dissociation, determination of Ka of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

Unit IV

VII. Electrochemistry - II:

a. Types of reversible electrodes- Gas-metal ion, metal-ion, metal-insoluble salt-anion and redox electrodes. Electrode reactions, single electrode potential, standard electrode potential. Reference electrode: standard hydrogen electrode and calomel electrode, Nernst equation, derivation of cell E.M.F., electrochemical series and its significance.

b. Electrolytic and Galvanic cells- Reversible and irreversible cells, conventional representation of electrochemical cells.

c. EMF of a cell and its measurements- Calculation of cell EMF. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K)

d. Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations.

VIII. Definition of pH and pKa, determination of pH using quinhydrone and glass electrodes by potentiometric methods. Buffers - Mechanism of buffer action, Henderson-Hazel equation. Hydrolysis of salts.

Books Suggested (Theory Courses)

a. Physical Chemistry. G.M. Barrow. International Student Edition, McGraw Hill.

b. Physical Chemistry, R.A. Alberty, Wiley Eastern Ltd.

c. The Elements of Physical Chemistry, P.W. Atkins, Oxford.

d. Physical Chemistry Through problems, S.K. Dogra and S. Dogra, Wiley Eastern Ltd.

e. Graduate physical Chemistry, Volume I-III By L.R. Sharma and M.S. Pathania

f. Principles of Physical Chemistry by B.R. Puri, L.P Sharma and M.S. Pathania, Vishal publication, Jallandhar.

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LUCKNOW
Four Year Undergraduate Course Structure
Subject: Chemistry Semester III
Chemistry Practical 2

Semester III **Paper 6 (P6)** **Credits 4**

Course Objective

Identify the thermodynamic systems and processes, understand the basic principles of phase diagram, solutions and colligative properties, and know how to apply them to explain and interpret the observations in other areas of chemistry and related fields. The course gives basic knowledge necessary for the Physical course based on solutions.

Course Outcome

CO-1. By interpreting the real gases, the student will be able to solve the problems.

CO-2. Describes the ideal and real gases.

CO-3. By interpreting some properties of liquids and solids, the student will be able to solve the problems.

CO-4. Interpreting the phase equilibrium in simple systems, the student will be able to answer the questions.

CO-5. Adopt distribution law to explain various phases.

CO-6. By describing the ideal solution, the student will be able to recognize, use and compare the colligative properties.

CO-7. Explain various reactions based on kinetics.

CO-8. describe the kinds of solutions.

Physical Chemistry

1. Chemical Kinetics
    a. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at room temperature.
2. Distribution Law
    a. To study the distribution of iodine between water and CCl4.
3. Colloids
    a. To prepare arsenious sulphide sol and compare the precipitating power of mono-, bi- and trivalent anions.
4. Viscosity, Surface Tension
    a. To determine the percentage composition of a given binary mixture (non interacting systems) by viscosity method.
    b. To determine the percentage composition of a given binary mixture (non interacting systems) by surface tension method (acetone & ethyl methyl ketone).
5. Phase Equilibrium

a. To construct the phase diagram of two component (e.g. diphenylamine benzophenone) system by cooling curve method.

6. Thermochemistry

   a. To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process.

   b. To determine the enthalpy of neutralisation of a week acid/weak base versus strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base.

Organic Chemistry

a. Sublimation

b. Crystallization

c. Identification of organic compounds with derivatives (solid compounds of all functional groups and liquid compounds.

Record and Viva

Books Recommended

a) Chemistry Practical by S. Giri, D.N. Bajpai and O.P. Shukla, S. Chand Publication.

b) Practical Chemistry Volume 1-3 by Fateh Bahadur, Vishal Publication

c) Advanced Physical Chemistry by J.B. Yadav, Goel Publication