



List of Revised Courses

Department : **Chemistry**

Programme Name : **B.Sc.**

Academic Year : **2020-21**

List of Revised Courses

Sr. No.	Course Code	Name of the Course
01.	PSCHGE0101L	Generic Elective - I
02.	PSCHGE0101P	Generic Elective - I Practical
03.	PSCHGE0202L	Generic Elective - 2
04.	PSCHGE0202P	Generic Elective - 2 Practical
05.	PSCHGE0303L	Generic Elective - 3
06.	PSCHGE0303P	Generic Elective - 3 Practical
07.	PSCHGE0404L	Generic Elective - 4
08.	PSCHGE0404P	Generic Elective - 4 Practical



Minutes of Meetings (MoM) of Board of Studies (BoS)

Academic Year : 2020-21

School : School of Physical Sciences

Department : Chemistry

Date and Time : Sept. 04, 2020 - 12:00 noon

Venue : Meeting room

The scheduled meeting of member of Board of Studies (BoS) of Department of Chemistry, School of Studies of Physical Sciences, Guru Ghasidas Vishwavidyalaya, Bilaspur was held to design and discuss the contents of each paper of U.G (CBCS) program and continuing elective course system (ECS) since 2009, P.G. program by members (both internal and external).

The following members were present in the meeting:

1. Prof. A. Mittal (External Expert Member BoS, Dept. of Chemistry, MNIT Bhopal)
2. Prof. G. K. Patra (Member BoS, Dept. of Chemistry, GGV.)
3. Prof. Tanmay Kumar Ghorai (HOD, Dept. of Chemistry-cum Chairman, BOS)
4. Dr. S. K. Singh (Member BoS, Associate Professor, Dept. of Chemistry)
5. Dr. S. Banerjee (Member, Assistant Professor, Dept. of Chemistry)

Following points were discussed during the meeting

1. The syllabus of Chemistry Generic Elective was thoroughly modified.
2. The content of existing Quantum Mechanics Paper [CMT-304(P)] of M.Sc. III Semester Physical Chemistry special was also modified on request of the teachers of Physical Chemistry Special.

The committee discussed and approved the scheme and syllabi. The following courses were revised in the B. Sc. (I, II, III and IV Semesters) and M. Sc. III Semesters:

- ❖ PSCHGE0101L Generic Elective - I
- ❖ PSCHGE0101P Generic Elective - I Practical
- ❖ PSCHGE0202L Generic Elective - 2
- ❖ PSCHGE0202P Generic Elective - 2 Practical
- ❖ PSCHGE0303L Generic Elective - 3
- ❖ PSCHGE0303P Generic Elective - 3 Practical
- ❖ PSCHGE0404L Generic Elective - 4
- ❖ PSCHGE0404P Generic Elective - 4 Practical
- ❖ CMT-304 (P) Quantum Chemistry

सहायक/Head
रसायन शास्त्र विभाग
Dept. of Chemistry
Signature & Seal of HoD
गुरु घासीदास विश्वविद्यालय,
Guru Ghasidas Vishwavidyalaya,
बिलासपुर 495009 (छ.ग.)
Bilaspur 495009 (C.G.)
Criteria - I (1.1.2)



Scheme and Syllabus

Annexure-I

Syllabus for Chemistry

B. Sc. GENERIC ELECTIVE COURSE

Department of Chemistry
Guru Ghasidas Vishwavidyalaya

*Generic Elective Course (GE)		
Course Code	Title of Paper	Credit
PSCHGE0101L	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	4
PSCHGE0101P	GE CHEMISTRY PRACTICAL - I	2
PSCHGE0202L	Kinetic Theory of Gases, Chemical Energetics, Equilibria & Functional Group Organic Chemistry	4
PSCHGE0202P	GE CHEMISTRY PRACTICAL - II	2
PSCHGE0303L	Solid, Solutions, Phase Equilibrium & Chemical kinetics, Conductance, Periodic Properties and Chemistry of s-, p-, and d- block elements	4
PSCHGE0303P	GE CHEMISTRY PRACTICAL - III	2
PSCHGE0404L	Analytical Chemistry, Co-ordination compounds, Organometallics and Molecules of life	4
PSCHGE0404P	GE CHEMISTRY PRACTICAL - IV	2

(Handwritten signatures and initials)



**Generic Elective Course (GE) (Minor-Chemistry) for other
Departments/Disciplines:**

**PSCHGE0101L : Atomic Structure, Bonding, General Organic
Chemistry & Aliphatic Hydrocarbons**

(Credits: Theory-04, Practicals-02)
Theory: 60 Hours

Section – A: Inorganic Chemistry – 1

Unit – 1: Atomic Structure

Review of Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.

What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2 , Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s . Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

(12 Hours)

Unit – 2: Chemical Bonding

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Nonbonding Interactions, Concept of resonance and resonating structures in various inorganic and organic compounds.

(10Hours)

Unit – 3: Molecular Orbital Theory

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including



idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO⁺. Comparison of VB and MO approaches.

(8 Hours)

Section – B: Organic Chemistry – I

Unit – 1: Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values.

(12 Hours)

Unit – 2: Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes and Cyclo alkanes: *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation. Baeyer strain theory.

Alkenes: *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. KMnO₄) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation.

Alkynes: *Preparation:* Acetylene from CaC₂ and conversion into higheralkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline KMnO₄, ozonolysis and oxidation with hot alk. KMnO₄.

(18 Hours)

Reference Books:

- J. D. Lee: *A new Concise Inorganic Chemistry*, E L. B. S.
- F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
- Douglas, McDaniel and Alexander: *Concepts and Models in Inorganic Chemistry*.
- James E. Huheey, Ellen Keiter and Richard Keiter: *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.
- T. W. Graham Solomon: *Organic Chemistry*, John Wiley and Sons.
- Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry*, Orient Longman.
- E. L. Eliel: *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
- I. L. Finar: *Organic Chemistry* (Vol I & II), E. L. B. S.
- R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
- ArunBahl and B. S. Bahl: *Advanced Organic Chemistry*, S. Chand
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PSCHGE0101P : GE CHEMISTRY PRACTICAL – I

(Credit: 02)
(60 Hours)

Section – A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with KMnO_4 .
3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO_4 .
4. Estimation of Fe (II) ions by titrating it with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $\text{Na}_2\text{S}_2\text{O}_3$.

Section – B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)
2. Systematic Qualitative Organic Analysis of Organic Compounds possessing mono functional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

Reference Books:

- Textbook of Practical Organic Chemistry, A.I. Vogel, Prentice Hall, 5th edition.
 - Practical Organic Chemistry, F. G. Mann. & B. C. Saunders, Orient Longman, 1960.
 - Vogel's Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
 - Vogel's Quantitative Chemical Analysis, A.I. Vogel, Prentice Hall, 6th Edition.
 - A. K. Nad, B. Mahapatra and A. Ghosal, An Advanced Course in Practical Chemistry, New Central Book Agency Priv. Ltd, 2011
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**PSCHGE0202L : Kinetic Theory of Gases, Chemical Energetics,
Equilibria & Functional Group Organic
Chemistry**

(Credits: Theory-04, Practicals-02)
Theory: 60 Hours

Section – A: Physical Chemistry – I

Unit – 1: Kinetic Theory of Gases

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation.

Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation, van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO₂.

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required).

Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules.

(10 Hours)

Unit – 2: Chemical Energetics

Chemical Energetics: Introduction of different terms and processes in thermodynamics: [systems (isolated, closed, open) and surrounding, macroscopic properties, state and path functions and their differentials.

First Law: concept of heat, q , work, w , internal energy, U , sign convention for heat and work, nature of work, path dependence of work and heat; statement of first law; enthalpy, H , heat changes at constant volume and constant pressure; heat capacities (C_v , C_p) and relation between them for ideal gases. Reversible and irreversible processes, maximum work, thermodynamic quantities (w , q , ΔU , ΔH) and its calculation for isothermal and adiabatic reversible expansion of ideal gases. Joule-Thomson effect, Joule Thomson coefficient in ideal and real (van der Waal) gases.

Thermo-chemistry: Standard state, standard enthalpy of formation, Hess's Laws of constant heat summation and its application. Change in internal energy (ΔU) and enthalpy (ΔH) of chemical reactions, relation between ΔU and ΔH , variation of heat of reaction with temperature (Kirchhoff's equation). Enthalpy of neutralization. Bond Energy – Bond dissociation energy and its calculation from thermo-chemical data.– Kirchhoff's equation.

Second law of thermodynamics, concept of entropy, free energy work functions, Gibbs Helmholtz equation.

(12 Hours)

Unit – 3: Chemical and Ionic Equilibrium



Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between G and G° . Le Chatelier's principle. Relationships between K_p , K_c and K_x for reactions involving ideal gases.

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions.

(8 Hours)

Section – B: Organic Chemistry – 2

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Unit – 1: Aromatic Hydrocarbons & Alkyl and Aryl Halides

Aromatic Hydrocarbons: Aromaticity: Benzenoids and Hückel's rule. *Preparation* (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. *Reactions:* (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene).

Alkyl and aryl Halides: *Preparation* of alkyl and aryl halides. *Reactions:* Nucleophilic Substitution (S_N2 , S_N1) reactions. S_NAr , Benzyne Mechanism

(10 Lectures)

Unit – 2: Alcohols, Phenols, Ethers, Aldehydes and Ketones

Alcohols and Phenol: *Preparation:* Preparation of 1° , 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. *Preparation:* Cumenehydroperoxide method, from diazonium salts.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). *Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction.

Ethers (Aliphatic and Aromatic): Cleavage of ethers with HI.

Aldehydes and Ketones (Aliphatic and Aromatic): Preparation of aldehyde and ketones. *Reactions* -Reaction with HCN, ROH, $NaHSO_3$, NH-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Ponndorf Verley reduction.

(12Hours)

Unit – 3: Carboxylic acids and their derivatives & Amines salt

Carboxylic acids (aliphatic and aromatic): *Preparation:* Acidic and Alkaline hydrolysis of esters. *Reactions:* Hell – Vohlard - Zelinsky Reaction.



Amines and Diazonium Salts: Amines (Aliphatic and Aromatic); *Preparation:* from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. *Reactions:* Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2 .

Diazonium salts: *Preparation:* from aromatic amines. *Reactions:* conversion to benzene, phenol, dyes.

(8Hours)

Reference Books:

- T. W. Graham Solomons: *Organic Chemistry*, John Wiley and Sons.
- Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry*, Orient Longman.
- R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
- ArunBahl and B. S. Bahl: *Advanced Organic Chemistry*, S. Chand.
- G. M. Barrow: *Physical Chemistry* Tata McGraw-Hill (2007).
- G. W. Castellan: *Physical Chemistry* 4th Edn. Narosa (2004).
- J. C. Kotz, P. M. Treichel & J. R. Townsend: *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry (Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- B. H. Mahan: *University Chemistry* 3rd Ed. Narosa (1998).
- R. H. Petrucci: *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).

PSCHGE0202P : GE CHEMISTRY PRACTICAL - II

(60 Hours)
(Practicals : 02)

Section – A: Physical Chemistry

Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Study of the solubility of benzoic acid in water and determination of H .

Ionic Equilibria

pH measurements

- a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.



- b) Preparation of buffer solutions:
(i) Sodium acetate-acetic acid
(ii) Ammonium chloride-ammonium hydroxide

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section – B: Organic Chemistry

1. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)
2.
 1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
 2. Preparations: Mechanism of various reactions involved to be discussed.
Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
 - (a) Preparation of phthalimide from phthalic acid
 - (b) Preparation of picrate derivatives
 - (c) Preparation of 2,4-DNP-derivatives

Reference Books

- A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
 - F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Orient Longman (1960).
 - Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry*, Universities Press
 - B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.
 - A. K. Nad, B. Mahapatra and A. Ghosal, An Advanced Course in Practical Chemistry, New Central Book Agency Priv. Ltd, 2011
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**PSCHGE0303L : Solid, Solutions, Phase Equilibrium & Chemical Kinetics,
Conductance, Periodic Properties and Chemistry of s-, p-, and d- block
elements**

(Credits: Theory-04, Practicals-02)
Theory: 60 Hours

Section – A: Physical Chemistry – 2

Unit – 1: Solids

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X-Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals.

(8 Hours)

Unit – 2: Solutions, Phase Equilibrium & Chemical Kinetics

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids. Nernst distribution law and its applications.

Phases, components and degrees of freedom of a system. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, FeCl₃-H₂O and Na-K only).

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half-life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

(15 Hours)

Unit – 3: Conductance

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.

Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base).

(7 Hours)

9 | Page



Section – B: Inorganic Chemistry – 2

Unit – 1: Periodic Properties & Acid-Base Concepts

Periodic Properties: Division of elements into *s*, *p*, *d*, and *f* blocks, covalent radii, van der Waals radii and ionic radii, ionization enthalpy, electron gain enthalpy, and electronegativity (Pauling, Mulliken, and Alfred-Rochow scales: Definition, methods of determination, trends in periodic table, and applications in predicting and explaining chemical behavior).

Acids and Bases: Arrhenius, Brønsted-Lowry, Lux-Flood and Lewis concepts of acids and bases. Factors affecting strengths of Lewis acids and bases, Classification of acids and bases as hard and soft, Pearsons HSAB concept, acid-base strength and hardness and softness, symbiosis, application of HSAB theory.

(10 Hours)

Unit – 2: Oxidation-Reduction

Redox equations, Standard electrode potentials, Ellingham diagrams for reduction of metal oxides using carbon as reducing agent, Nernst equation, redox potentials to explore the feasibility of reaction and calculation of values of equilibrium constant. Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell.

(6 Hours)

Unit – 3: Chemistry of *s*-, *p*- and *d*- Block Elements

s-Block Elements: General characteristics, complexes of alkali metals, comparative study of hydrides, oxides, hydroxides, halides, carbonates and bicarbonates of group I and II, Diagonal relationship, Biological role of alkali and alkaline earth metals.

p-Block Elements: General characteristics, comparative study (including diagonal relationship and inert pair effect) of groups 13-17 (B, C, N, O, F) elements and group trends of compounds like hydrides, oxides, halides, and oxy acids; preparation properties and structure, of diborane, borazine, borohydrides, fullerenes, silicates and silicones, inter-halogen, polyhalides and pseudohalides.

Chemistry of Noble Gases: Isolation and separation of noble gases from air, chemical properties of noble gases, structure and bonding in xenon compounds.

d-Block Elements: Characteristics of *d*-block elements. Properties of the elements of the first non-transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. Comparative study with their 3d-analogues in respect of ionic radii, oxidation states and stereochemistry.

(14 Hours)

Reference Books:

- G. M. Barrow: *Physical Chemistry* Tata McGraw-Hill (2007).
- G. W. Castellan: *Physical Chemistry* 4th Ed. Narosa (2004).
- J. C. Kotz, P. M. Treichel, J. R. Townsend, *General Chemistry*, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
- B. H. Mahan: *University Chemistry*, 3rd Edn. Narosa (1998).



- R. H. Petrucci, *General Chemistry*, 5th Edn., Macmillan Publishing Co.: New York (1985).
- E. S. Gilreath, *Fundamental Concepts of Inorganic Chemistry*, Mc Graw Hill Edu. Pvt. Ltd.
- R. Sarkar (Part-I & II), *General & Inorganic Chemistry*, Central
- R. L. Dutta (Part-I & II), *Inorganic Chemistry*, The New Book Stall
- J. D. Lee: *A New Concise Inorganic Chemistry*, E.L.B.S.
- F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
- D. F. Shriver and P. W. Atkins: *Inorganic Chemistry*, Oxford University Press.
- Gary Wulfsberg: *Inorganic Chemistry*, Viva Books Pvt. Ltd.

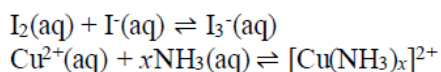
PSCHGE0303P : GE CHEMISTRY PRACTICAL – III

(60 Hours)

Section – A: Physical Chemistry

Distribution

Study of the equilibrium of one of the following reactions by the distribution method:



Phase equilibria

- Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
- Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.
- Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

(I) Surface tension measurement (use of organic solvents excluded).

- Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
- Study of the variation of surface tension of a detergent solution with concentration.

(II) Viscosity measurement (use of organic solvents excluded).

- Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
- Study of the variation of viscosity of an aqueous solution with concentration of solute.

(III) Chemical Kinetics

Study the kinetics of the following reactions.



1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:
 - a. Acid hydrolysis of methyl acetate with hydrochloric acid.
 - b. Saponification of ethyl acetate.
 - c. Compare the strengths of HCl and H₂SO₄ by studying kinetics of hydrolysis of methyl acetate

Conductance

- a) Determination of cell constant
- b) Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
- c) Perform the following conductometric titrations:
 - i. Strong acid vs. strong base
 - ii. Weak acid vs. strong base

Potentiometry

Perform the following potentiometric titrations:

- a) Strong acid vs. strong base
- b) Weak acid vs. strong base
- c) Potassium dichromate vs. Mohr's salt

Section – B: Inorganic Chemistry

Semi-micro qualitative analysis using thioacetamide- not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

Cations : NH₄⁺, Pb²⁺, Ag⁺, Bi³⁺, Cu²⁺, Cd²⁺, Sn²⁺, Fe³⁺, Al³⁺, Co²⁺, Cr³⁺, Ni²⁺, Mn²⁺, Zn²⁺, Ba²⁺, Sr²⁺, Ca²⁺, K⁺, Anions : CO₃²⁻, S²⁻, SO₃²⁻, S₂O₃²⁻, NO₃⁻, NO₂⁻, Cl⁻, Br⁻, I⁻, SO₄²⁻, PO₄³⁻, BO₃³⁻, C₂O₄²⁻, F⁻

(Spot tests should be carried out wherever feasible)

Reference Books:

- B.D. Khosla: Senior Practical Physical Chemistry, R. Chand & Co.
- A.I. Vogel, Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
- A.I. Vogel, Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- A. K. Nad, B. Mahapatra and A. Ghosal, An Advanced Course in Practical Chemistry, New Central Book Agency Priv. Ltd, 2011
- V. K. Ahluwalia, S. Dhingra & A. Gulati, College Practical Chemistry, University Press, Delhi



PSCHGE0404L : Analytical Chemistry, Co-ordination compounds,

Organometallics and Molecules of life

(Credits: Theory-04, Practicals-02)

Theory: 60 Hours

Section – A: Analytical Chemistry – 3

Unit – 1: Introduction

Introduction to Analytical Chemistry and its interdisciplinary nature. Balances, burettes, volumetric flasks, pipettes, calibration of tools, sampling. Errors and Statistics: significant figures, rounding off, accuracy and precision, determinate and indeterminate errors, standard deviation, propagation of errors, confidence limit, test of significance, rejection of a result.

(8 Hours)

Unit – 2: Volumetric Titration

Standard solution, primary standard and secondary standard, titration, end point, indicator, concentration of standard solution- moles, Normality, molarity, Molality, parts per million (PPM), volumetric calculation, acid base titration and use of indicators, titration curves for strong acid vs strong base, weak acid with strong base, weak base with strong acid, theory of acid base indicator, Redox titration- titration of Mohr salt against KMnO_4 , Titration of Oxalic acid against KMnO_4 , Titration of FeSO_4 against $\text{K}_2\text{Cr}_2\text{O}_7$.

(8 Hours)

Unit – 3: Chromatography

Chromatographic Techniques: classification, theory of chromatographic separation, distribution coefficient, retention, sorption, efficiency and resolution. - Column, ion exchange, paper, TLC & HPTLC chromatography etc.

Solvent Extraction: Distribution Coefficient, distribution ratio, percent extracted, solvent extraction of metals ions, extraction of ion association complex, extraction of metal chelates, multiple batch extraction and applications.

(4 Hours)

Section – B: Inorganic Chemistry – 3

Unit – 1: Coordination Compounds

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of co-ordination compounds, isomerism in coordination compounds.

Crystal Field Theory: Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for O_h and T_d complexes.

(10 Hours)

Unit – 2: Organometallics

Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multi centre bonds) in metal carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals, Zeiss salt and ferrocene. EAN rule.



(10 Hours)

Section – C: Organic Chemistry – 3

Unit – 1: Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis - trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

(7 Hours)

Molecules of Life

Unit – 2: Carbohydrates

Classification of carbohydrates, and General Properties, Glucose open chain structure. Epimers, mutarotation and anomers, Applications of carbohydrates.

(6 Hours)

Unit – 3: Amino Acids, Peptides, Proteins

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis.

Reactions of Amino acids: ester of –COOH group, acetylation of –NH₂ group, complexation with Cu²⁺ ions, ninhydrin test.

Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins.

(7 Hours)

Reference Books:

- Skoog, D.A.; West, D.M. & Holler, F.J. *Fundamentals of Analytical Chemistry 6th Ed.*, Saunders College Publishing, Fort Worth (1992).
- Dean, J. A. *Analytical Chemistry Notebook*, McGraw Hill.
- Vogel, A. I. *Vogel's Qualitative Inorganic Analysis 7th Ed.*, Prentice Hall.
- G. M. Barrow: *Physical Chemistry* Tata McGraw-Hill (2007).
- G. W. Castellan: *Physical Chemistry* 4th Edn. Narosa (2004).
- J. C. Kotz, P. M. Treichel & J. R. Townsend: *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- B. H. Mahan: *University Chemistry* 3rd Ed. Narosa (1998).
- R. H. Petrucci: *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
- J. D. Lee: *A New Concise Inorganic Chemistry*, E.L.B.S.
- F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
- D. F. Shriver and P. W. Atkins: *Inorganic Chemistry*, Oxford University Press.
- R. L. Dutta (Part-I & II), *Inorganic Chemistry*, The New Book Stall.
- Gary Wulfsberg: *Inorganic Chemistry*, Viva Books Pvt. Ltd.
- S. Chand, Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.*, W. H. Freeman.



PSCHGE0404P : GE PRACTICAL – IV (Electrochemistry, Chemical Kinetics, Co-ordination compounds, Organometallics and Molecules of life

(60 Hours)

Section – A: Analytical Chemistry

1. Estimation of the amount of nickel present in a given solution as bis(dimethylglyoximate) nickel(II) or aluminium as oxinate in a given solution gravimetrically.
2. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.
3. Estimation of total hardness of a given sample of water by complexometric titration.
4. To draw calibration curve (absorbance at λ_{max} vs. concentration) for various concentrations of a given coloured compound and estimate the concentration of the same in a given solution.
5. Determination of the composition of the Fe^{3+} - salicylic acid complex / Fe^{2+} - phenanthroline complex in solution by Job's method.
6. Determination of concentration of Na^+ and K^+ using Flame Photometry.

Section – B: Inorganic Chemistry

1. Separation of mixtures by chromatography: Measure the R_f value in each case.
(Combination of two ions to be given)
Binary mixture of nickel and cobalt, copper and nickel, zinc and magnesium, iron and copper; aluminium and nickel.

2. Preparation of any two of the following complexes:

- (a) tetraammine copper (II) sulphate
- (b) tetraamminecarbonatocobalt (III) nitrate
- (c) potassium trioxalatochromate (III)
- (d) potassium trioxalatoferrate (III)
- (e) sodium hexanitritocobaltate (III)
- (f) prussian blue

Section – C: Organic Chemistry

1. Determination of the concentration of glycine solution by formylation method.
2. Titration curve of glycine
3. Action of salivary amylase on starch
4. Determination of the saponification value of an oil/fat.
5. Determination of the iodine value of an oil/fat
6. Differentiation between a reducing/nonreducing sugar.



Reference Books:

- Skoog, D.A.; West, D.M. & Holler, F.J. *Fundamentals of Analytical Chemistry 6th Ed.*, Saunders College Publishing, Fort Worth (1992).
- Dean, J. A. *Analytical Chemistry Notebook*, McGraw Hill
- Vogel, A. I. *Vogel's Qualitative Inorganic Analysis 7th Ed.*, Prentice Hall
- Vogel, A. I. *Vogel's Quantitative Chemical Analysis 6th Ed.*, Prentice Hall
- G. M. Barrow: *Physical Chemistry* Tata McGraw-Hill (2007).
- G. W. Castellan: *Physical Chemistry* 4th Edn. Narosa (2004).
- B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.
- A.I. Vogel, Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
- A.I. Vogel, Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- A. K. Nad, B. Mahapatra and A. Ghosal, An Advanced Course in Practical Chemistry, New Central Book Agency Priv. Ltd, 2011
- V. K. Ahluwalia, S. Dhingra & A. Gulati, College Practical Chemistry, University Press, Delhi

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