Chemistry

B.Sc. Chemistry-I **Total Mark: 100**

Part-I

(Outlines of Tests)

Paper-A:	Physical Chemistry (Written)	:	35 Marks
Paper-B:	Inorganic Chemistry (Written)	:	35 Marks
Paper-C:	Physical Chemistry (Practical)	:	15 Marks
Paper-D:	Inorganic Chemistry (Practical)	:	15 Marks

(Syllabi and Courses of Reading)

Paper-A: Physical Chemistry **35 Marks**

It is compulsory to attempt atleast two questions from each section.

Section-I

1. States of Matter:

(i) Gases:

Law of equipartition of energy, Collision diameter, collision number, 'collision frequency and mean free path, Viscosity of gases, measurements, effect of temperature and pressure on viscosity of gases, Vander-Waal equation for derivation of P_c, V_c and T_c in term of Vander-Waal constants and experimental determination of P_c, V_c, T_c, Concept of molecular velocities of gases according to Maxwell's distribution law and comparison of molecular velocities.

(ii) Liquids:

The properties of liquids like surface tension, viscosity, refractive index and dipole moment; Parachor, reheochor and molar refraction as additive, and constitutive properties, Measurement of refractive index and dipole moment, Magnetic susceptibility and its measurement by Gouy's balance.

(iii) Solids:

Symmetry operations and Bravis lattices, Concept of X-ray diffraction, Bragg's equation and crystal structure analysis, Powder method of crystal structure analysis, X-ray crystallography of sodium chloride crystal, Heal capacities of solids.

2. Chemical Thermod Ynamics:

1^{st}law of thermodynamics, Molar heat capacities, Relation between C_p and C_v, Isothermal reversible expansion of an ideal gas, Reversible adiabatic expansion of an ideal gas, work

donein adiabatic reversible expansion, 2^{nd} law of thermodynamics, Heat engine, Carnot heat engine and its efficiency, Concept of entropy, Entropy change in phase transition. Entropy change in reversible and irreversible processes, Entropy change for an ideal gas, Entropy change due to mixing of ideal gases, Temperature dependence of entropy, Variation of entropy with temperature and pressure, Concept of free energy, Derivation of Gibb's and Helmholtz's free energy equations, Variation of free energy with temperature andpressure, Relation between ΔG^o and equilibrium constant, Partial molar quantities, Chemical potential, variation of chemical potential with pressure and temperature, fugacity, Vont's Hoff isochore, The Clausius-Clapeyron equation and its applications, Molecular basis of entropy and probability.

3. Chemical Kinetics:

Derivation of kinetic expression of zero order, first order, second order (with same and different concentration) and third order reactions (with same concentrations), Nuclear decay as a first order reaction, Derivation of equations for determination of rate constant and half life periods, Measurement of order of reactions with different methods, Arrhenius equation and determination of Arrhenius parameters, Bimolecular collision theory of reaction rates and its failures, Uni-molecular gas phase reactions (Lindeman mechanism), Transition state theory of reaction rates.

4. Basic Mathematics for Chemistry:

Concept of function, Equation of straight lines, Use of simultaneous equations in chemistry, Use of Quadratic equation in chemical equilibrium, Differentiation of simple functions, Concept of maxima, minima and point of inflexion, Partial differentiation, Integration of simple functions, Variable separable first order differential equations and their use in chemistry (One question is mandatory from this chapter).

Section-II

5. Quantum Mechanics and a Tomic Structure:

Postulates of quantum mechanics, Brief introduction to operators, Elementary treatment of Compton effect and photoelectric effect, Brief discussion of result of Bohr's Model and its defects, Somerfield's modification and evolution of Azimuthal quantum number, Dual nature of matter, verification of dual nature by Davisson and Germer's experiment, Heisenberg's uncertainly principle, Derivation of time independent Schrodinger wave equation in terms of polar coordinates and derivation of Principal quantum number, Energy equation for free motion of particle in one- dimensional box. Electronic spectra of polyenes as an example of particle in ID box, Quantum mechanical Tunneling, Eigen values and Eigen functions,

normalization of wave function. Probability functions, radial distribution, probability density functions.

6. Solutions:

Thermodynamic derivation of colligative properties as lowering of vapour pressure, elevation of boiling point, depression of freezing point, Relationship between lowering of vapor pressure with ΔT_m and ΔT_fOsmotic pressure and its determination; Concept of semi permeable membrane, Isotonic solution, theory of Osmosis, Laws of osmotic pressure, Relationship between vapour pressure and osmotic pressure, Abnormal colligalive properties describing association and dissociation of solutes; Fractional distillation and idea of azeotropes in detail, Nernst distribution law, its limitations and its applications in chemistry.

7. Electrochemistry:

Concept of electrolytic conduction and Ohm's law, Specific, equivalent and molar conductance, Determination of resistance, Cell constant, conduction of strong and weak electrolytes, Ionic mobilities and their determination; Kohlrausch's law and its applications; Faraday's laws of electrolysis and their significance; Transport number, Hittorfs rule, Applications of conductance measurement; Ostwald's dilution law and determination of degree of dissociation of weak electrolyte, Conductometric titrations, Modes of mass transfer in electrochemical cells; Thermodynamics of electrochemical cells, The Nernst equation, Temperature dependence of EMF Electrode potential and its measurement with reference to Weston standard, glass electrode, calomel electrode and quihydrin electrode, Concentration cells and its types,. Concentration cells with and without liquid junction.

8. Surface Chemistry:

Introduction to adsorption, Difference between physical and chemical adsorption, Freundlich adsorption isotherm and Langmuir adsorption isotherm and their applications, Brief introduction to catalysis, Theories of catalysis, Catalytic reaction of a gas on solid surface, Activation energy of enzyme catalyzed reaction, Kinetics of autocatalysis and enzyme catalysis.

Recommended Books:

1. Atkin, P. and J. D. Paula, 2002. Atkin's Physical Chemistry 2nd Edition, Oxford University Press. New York.
2. Bhatti H.N and Z. H. Farooqi. 2014. Modern Physical Chemistry. Caravan Book House (Revised Ed.) Pakistan.

3. Barrante, J. R. 1998. Applied Mathematics for Physical Chemistry. Prentice Hall (3rd Ed.) USA.
4. Peter, T. 1998. Basic Mathematics for Chemists. John Wiley and Sons (2nd Ed) USA.
5. Sana-Ullah, C. 2010. A Text Book of Physical Chemistry. Markazi Kutab Khana Pakistan.
6. Nabi, G.; M. N. Akhtar and B. A. Khokhar. 2010. Physical Chemistry. Ilmi Kitab Khana Pakistan.
7. Rasool, G. 2010. A Text Book of Physical Chemistry. Azeem Publishers Pakistan.
Bahl, A; B. S. Bahl and G. D. Tuli. 2012. Essentials of Physical Chemistry. S. Chand & Company Ltd. India.
8. Laidler, K. J.; J. PI. Meiser and B. C. Sanctuary. 2002. Physical Chemistry. Houghton Mifflin Harcourt USA.
9. Castellan, G. W. 1971. Physical Chemistry. Addison Wesley Publishing Company (2nd Ed) USA.
10. Silbey, R. J.; R. A. Alberty and M. G. Bawendi. 2004. Physical Chemistry. John Wiley and Sons USA.
11. Bhatti H. N. and K. Hussain. 2006. Principles of Physical Chemistry. Caravan Book House Pakistan.
12. Maeder, M. and Neuhold, Y-M. 2007. Practical Data Analysis in Chemistry. Elsevier UK.

Paper-B: Inorganic Chemistry 35 Marks

It is compulsory to attempt atleast two questions from each section.

Section-I

1. Periodicity:

Modern periodic table, Similarities and differences among first Row elements, their diagonal and vertical relationship with other elements, electro-negativity of elements (Pauling and Mulliken scales), Polarizability and polarizing power of ions, Periodicity in the properties of outer transition and inner transition elements.

2. Theories Of Chemical Bond Ind:

Nature and types of Chemical Bonding, Modern concept of Valence Bond Theory (VBT), Molecular Orbital Theory (MOT) and their applications to Homo and hetero di-and polyatomic inorganic molecules, explaining the conventional and modified MO diagrams. Valence Shell Electron Pair Repulsion Theory (VSEPR), explaining the shapes of inorganic molecules (i.e.

AB_2 AB_3, AB_2E, AB_4, AB_3E, AB_2E_2, AB_5, AB_4E, AB_3E_2, AB_2E_3, AB_6, AB_5E, AB_4E_2) and directed valence bond theory (Hybridization), Metallic bonds (detailed concept).

3. Acid-Base Concept:

General concept of acids and bases, Detail of Lewis concept of acids and bases, Soft and Hard Acid-Base (SHAB) concept and its applications, Relative strength of acids and bases based on pka values, Leveling effect, Reaction of Acids and Bases, Relationship between redox reactions and acid base reactions, Indicators and theory of indicators.

4. Essentials of Chemical Analysis:

Law of mass action and its applications, Precipitation and solubility product, Common ion effect and its application in salt analysis, Co-precipitation, Fractional precipitation

Section-II

5. Chemistry of D-Block Elements:

Electronic configuration and oxidation states of transition elements, Theories of coordination compounds, Valence Bond Theory (VBT), Molecular Orbital Theory (MOT) and Crystal Field Theory (CFT) for tetrahedral and octahedral complexes, Nomenclature, Isomerism in coordination compounds, Chelates, Application of coordination compounds.

6. Nuclear Chemistry:

Phenomena of radioactivity, Natural radioactivity, Radioactive disintegration series, Rale of disintegration and half life period, Mass defect and binding energy, Nuclear stability with respect to magic numbers and n/p rule, Measurement of nuclear radiation (Wilson Cloud Chamber and Geiger-Muller Counter), Carbon dating, Artificial radioactivity, Nuclear transformations, Nuclear reactions (Fission and Fusion), Uses of radioactive isotopes, Biological effects of nuclear radiations.

7. Chromatographic Techniques:

Basic principle of chromatographic techniques, Classifications of chromatographic techniques on the basis of mobile and stationary phases, Detailed concept and applications of column and thin layer chromatography.

Recommended Books:

1. Bhatti, H. N. and Rahman, R. 2013. Text Book of Inorganic Chemistry. Caravan Book House Pakistan.
2. Lee, J. D. 1996. Modern Inorganic Chemistry. Chapmann Hall (5thEd) England.

3. Colton, F. A.; Willkinson, G and Gaus, P. L. 1995. Basic Inorganic Chemistry. John Wiley and Sons Inc, England.
4. Shriver, D. F.; Atkins, P. W and Langford, C. H. 1996. Inorganic Chemistry, Oxford (2nd Ed) England..
5. Sharp, A. G. 1992. Inorganic Chemistry, Longman (3rd Ed) England.
6. Geiof R. C. 1995. Descriptive Inorganic Chemistry. MacMillan & Co. England.

Paper-C: Physical Chemistry (Practical) 15 Marks

Physical Chemistry:

1. Determination of percentage composition by surface tension, viscosity and refractive index method.
2. Determination of heat of solution of solids and liquids.
3. Quantitative measurement of coloured salt $KMnO_4$ and $K_2Cr_2O_7$ by colorimetery.
4. Conductometeric and potentiometric strong acid-base titrations using conductometer and pH meter respectively.
5. Investigation of kinetics of hydrolysis of ethyl acetate in the presence of hydrochloric acid at room temperature.
6. Measurement of molecular weight by depression in freezing point.
7. Determination of transition temperature of Na_2SO_4-$10H_2O$. $Na_2CO_3 10H_2O$ and $MgSO_4$-$7H_2O$.
8. Verification of Langmuir adsorption isotherm and investigation of adsorption of oxalic acid on charcoal.
9. Verification of Freundlich's adsorption isotherm by investigation of adsorption of oxalic acid on charcoal.

Recommended Books:

1. Crockford, H. D.; J. IV Nowell; H. W Baird and F. W. Getzen. 1976. Laboratory Manual of Physical Chemistry. John Wiley and Sons (2nd Ed.) England.
2. Das R. C. and B. Bahera. 1984. Experimental Physical Chemistry. Tata McGraw Hill Publishing Company Limited USA.
3. Levitt B. P. 1972. Findlay's Practical Physical Chemistry. Longman Group Limited (9th Ed.) USA.
4. Bhatti H. N. and Z. H. Farooqi. 2014. Physical Chemistry Laboratory Manual for B.Sc. Students. Caravan Book House (Revised Ed.) Pakistan.

Paper-D: Inorganic Chemistry(Practical): 15 Marks

1. Separation and identification of two acid and two basic radicals from a mixture of two salts.
2. Separation and identification of Cationic/Basic radicals of Group I, IIA, IIB and III. Also calculate their Rf values.
3. Determine the %age purity of NaCl (rock salt) by Mohr's method.
4. Determine the amount of NaCl in the commercial sample of salt by Mohr's method.
5. Determination of iodide and KI in the given sample solution by iodometry.
6. Standardization of $Na_2S_2O_5H_2O$ solution by iodometry.
7. Determination of amout/dm^3 of Cu^2 and $CuSo_4.5H_2O$ using $Na_2S_2O_3$ and KI by iodometry.
8. Determination of number of water molecules (x) in $CuSO_4$ XH_2O iodometrically.
9. Determination of amount/dm^3 of $FeSO_4$-$7H_2O$ with $K_2Cr_2O_7$ by both internal and external indicators.
10. Determination of %age purity of $K_2Cr_2O_7$ by using standard solution of Mohr's salt by both internal and external indicators.
11. Determination of no. of water molecules (x) in $FeSO_4$ xH_2O using $K_2Cr_2O_7$ by both internal and external indicators.
12. Determination of%age of iron in Ferric alum $(NH_4)2SO_4$ $Fe_2(SO_4)_3$ $24H_2O$ using $K_2Cr_2O_7$ by both internal and external indicators.
13. Standardization of EDTA solution by Magnesium sulfate/Zinc Sulfate solution by complexometry.
14. Find out the amount of Ca^{2+} in the given sample of marble (lime stone) by complexometry.
15. Determination of Ca^{2+} and Mg^{2+} in the sample by using EDTA by complexometry.

Recommended Books:

1. Jefferey, G. H.; Bassett,Menclham, J. and Denney, R. C. 1989. Vogel's TexBook of Quantitative Chemical Analysis. Benjamin Cummings (5th Ed) UK.
2. Vogel, A. I. A. 1995. Text Book of Macro and Semi micro Qualitative Inorganic Analysis, Longamn Green & Co England.
3. Skoog, D. A.; West, D. M. and. Holler, F. J. 1994. Analytical Chemistry. Saunders College Publications (6th Ed).
4. Amin, I. J. 2002. Theory and Practice of Chromatography, Higher Education Commission Pakistan,

5. Bhatti, IT. N. and Rahman, R. 2013. Text Book of Inorganic Chemistry. Caravan Book House Pakistan.
6. Pass, G., Sutcliffe, II. 1975. Practical Inorganic Chemistry, Preparations, Reactions and Instrumental Methods, 2nd ed., Chapman and Hall England.

Chemistry

B.Sc. Chemistry-II **Total Mark: 100**

Part-II

(Outlines of Tests)

Paper-A:	Organic Chemistry (Written)	:	35 Marks
Paper-B:	Applied Chemistry (Written)	:	35 Marks
Paper-C:	Organic Chemistry (Practical)	:	15 Marks
Paper-D	Applied Chemistry (Practical)	:	15 Marks

(Syllabi and Courses of Reading)

Paper-A: Organic Chemistry **35 Marks**

It is compulsory to attempt atleast two questions from each section.

Section-I

1. BASIC CONCEPTS IN ORGANIC CHEMISTRY

Hybridization of orbitals of carbon atoms in alkanes, alkenes, alkynes and arenes, Hybridization of orbitals of nitrogen, oxygen and sulfur atoms in various functional groups, Localized and delocalized chemical bonding, Conjugation and hyper conjugation, Resonance, rules of resonance, resonance energy, resonance hybrid, factor effecting the resonance, Hyperconjugation, Inductive effect, Applications of hyperconjugation, inductive effect and resonance on various properties of organic compounds, Steric effect and its applications, Hydrogen bonding and its effects on various properties of organic compounds, Tautomerism.

2. NOMENCLATURE OF ORGANIC COMPOUNDS

Nomenclature of alkanes, alkenes, alkynes, cycloalkanes, bicycycloalkanes, spiroalkanes, monofunctional and polyfunctional derivatives of open chain and cyclic compounds, polysubstituted benzenes, polycyclic hydrocarbons such as naphthalene, anthracene, phenanthrene and their derivatives, heterocyclic compounds.

3. HYDROCARBONS

Alkanes and Cycloalkanes: Preparation of alkanes from alkyl halides, coupling of alkyl halide and alkylboranes, reduction of carbonyl compounds, Kolbe's electrosynthesis, Corey-House-Synthesis, Hydrogenation of alkenes and alkynes.

Reactions of alkenes with halogens, their mechanism and comparison of the reactivities of halogens, combustion, isomerization, nitration and sulfonation. Preparations of cyoloalkanes by Freund synthesis, Hydrogenation of cyclic elkenes, Structure and stability of cycloalkanes, Reaction of cycloalkanes.

Alkenes and Alkynes: Preparation of alkenes from elimination reaction of alkyl halides and alcohols, Mechanism and orientation of eliminations, Dehalogenation of vicinal dihalides with mechanism, Pyrolytic eliminations.

Relative stability and reactivity of alkenes in terms of Hoffmann and Sytzeff rules, Reactions of alkenes: addition of halogens, additions of halogen acids and the rules governing these reactions, hydration reactions, oxidation reactions including epoxidation and hydroxylation, polymerization, Simon-Smith and Diels-Alder reactions.

Preparation of alkynes by carbide process, dehydrohalogenation of dihalides and alkylation of terminal alkynes.

Reactions of alkynes: addition reactions with mechanisms, hydration reactions, oxidation and reduction, hydroboration, formation of metal acetylides, polymerization (linear and closed Chain).

Aromatic Hydrocarbons: Structure of benzene, Resonance energy of benzene, Aromaticity, Criteria for aromaticity, Evidences of aomaticity, Natural sources of aromatic hydrocarbons, Prepartion of aromatic hydrocarbons by different methods.

Reaction of aromatic hydrocarbons: electrophilic aromatic substitution reactions
e. nitration, halogenation, Friedel-Crafts reactions and their limitations, sulfonation, Orientation and reactivity of substituted benzenes, Nucleophilic aromatic substitution reactions,

Reaction such as addition, hydrogenation, Birch reduction, and oxidation reactions of side chains.

Polycylic aromatic hydrocarbons, naphthalene, anthracence and phenantharene, their resonance structures and relative stabilities. Synthesis of naphthalene, Electrophilic substitution reactions of naphthalene, Brief description of orientation and reactivity of naphthalenes. Oxidation and reduction reactions.

4. ALKYL HALIDES

Preparation of alkyl halides from alcohols and carboxylic acids.Chemical reactions: Aliphatic nucleophilic substitution reactions, SN1 and SN2 mechanism, effects of the nature of substrate, attacking nucleophile, leaving group and the nature of solvent. Elimination reactions, ' E1 and E2 mechanisms, orientation of elimination (Hoffmann and Sylzeff rules).

Grignard Reagents, synthesis, structure, and reactions with active hydrogen compounds, carbonyl compounds such as aldehydes, ketones, esters, acid halides and CO2, reaction with nitriles, ethylene oxide, sulphur and oxygen.

Section-Il

5. CHEMISTRY HYDROXYL GROUP CONTAINING COMPOUNDS AND ETHERS

Alcohols: Physical properties, Preparation of alcohols by the reduction of carbonyl compound,, Reactions of alcohol with metals, organic and inorganic acids, Oxidation of alcohols, Distinction between primary, secondary and tertiary alcohols, Preparation of diols, triols and their important reactions and uses.

Phenols: Physical properties, Synthesis of phenols, Reactions of phenols such as acylation, Friedel-Crafts reaction, nitration, sulfonation, carbonation, formylation and diazo coupling.

Ethers: Physical properties, Preparation of ether from alcohols, alkyl halides and alkenes, Reactions of ethers.

6. CHEMISTRY OF CARBONYL COMPOUNDS

Preparation of aldehydes and ketones, by pyrolysis of calcium salts of acids, acylation of alkenes and arenes, reduction of acid halides and nitriles.

Physical properties of aldehydes and ketones, Structure and reactivity of carbonyl group, Comparison of the reactivity of aldelydes and ketones, Nucleophilic additions of water, alcohols, ammonia and its derivatives, hydrogen cyanide, bisulfite, reduction and oxidation reactions, Aldol condensation and related reactions, Cannizaro's reaction, Wittig reaction, oxidation reactions, Chemical tests of aldehydes and ketones.

7. CHEMISTRY OF CARBOXYLIC ACIDS AND THEIR DERIVA TIVES

Physical properties of carboxylic acids, Effects of different parameters on the acid strengths of aliphatic and aromatic carboxylic acids. Chemical properties, like salt formation nucleophilic acyl substitution, reduction of carboxylic acids, decarboxylation, Hunsdicker reaction, Koehl reaction, substitution at a-carbon. Preparations, properties and reactions of acids chlorides, acids anhydrides, amides, cyanides, and esters, Malonic and acetoacetic esters syntheses.

Recommended Books:

1. Younas, M. 2003. Text Book of Organic Chemistry, IImi Kutab Khana Pakistan.
2. Rehmen. A. 2000. Text Book of Organic Chemistry, Carvan Book House Pakistan.
3. Smith, M. B. and March, J. 2006. Advance Organic Chemistry, John Wiley & Sons (6th Ed) USA.
4. Pine, S. H. 1987. Organic Chemistry. McGraw Hill Inc. (5th Ed) USA.

Paper-B: Applied Chemistry **35 Marks**

It is compulsory to attempt atleast two questions from each section.

Section-I

1. SPECTROSCOPY

Electromagnetic radiation and its interaction with matter, Nature of different transitions possible in atoms and molecules, Electronic, vibrational, rotational and other possible transitions by absorption of radiation by molecules and atoms, Development of spectroscopic analytical techniques employing various transitions, Classification of spectroscopic techniques on the basis of type of radiation, phenomenon occurring and the nature of the matter. Basic introduction to atomic and molecular spectroscopic techniques including flame emission, spectrophotometry, UV and IR spectroscopies.

2. Environmental Chemistry

Introduction to Environment and its Segments, Natural Cycles (Water cycle, Nitrogen, Cycle and Oxygen Cycle), Green House effect and Global Warming, Acid Rain and its impact on Environment, Sources of pollution (Soil, Air and Water), Heavy metal pollution in water bodies.

3. SOLVENT EXTRACTION

Basics of solvent extraction process, Distribution law and distribution co-efficient, Simple, double extraction and multiple extraction systems, Applications of solvent extraction in chemistry.

4. EVALUATION OF ANALYTICAL DATA

Concepts of mean, mode and median, accuracy, precision, Determinate and indeterminate errors, Significant figures, Rounding off, Standard deviation, relative standard deviation. Application of mean, median, mode, rounding off significant figures and standard deviation in chemistry.

Section-II

5. CHEMICAL INDUSTRIES AND METALLURGIES

Raw materials, manufacturing process and flow sheet diagrams of following chemical Industries.

Glass, Cement, Sugar, Urea, Soda ash and Soap. Metallurgies of Copper, Aluminum and Iron.

6. CARBOHYDRATES, LIPIDS AND PROTEINS:

- Definition and classification, chemistry, physical and chemical properties of various classes of carbohydrates, biological functions of starch, glycogen, cellulose, and cell wall polysaccharides, acid mucopolysaccharides and proteoglycans.

- ***Definition and classification of lipids***, biological importance of fatty acids, waxes, glycerides, Steroids, phospholipids, sphingolipids, glycolipids, sterols and prostaglandins. Significance of lipids in biological membranes and transport mechanism.
- ***Chemistry and classification of amino acids***, physical and chemical properties of amino acids, biological significance of amino acids, peptides, proteins, their classification, properties and biological significance, primary, secondary tertiary and quatenary structure of proteins, denaturation of proteins.

Recommended Books:

1. Bhatti H.N and Z. H. Farooqi. 2014. Modern Physical Chemistry. Caravan Book House (Revised Ed.) Pakistan
2. Prutton, S. H. and Prutton, C. F. 1971. Principles of Physical Chemistry. MacMillan USA.
3. Castellan, G. W. 1971. Physical Chemistry. Addison Wesley Publishing Company (2nd Ed) USA.
4. Younas, M. 2003. Text Book of Organic Chemistry, IlKutab Khana Pakistan.
5. Bhatti, IT. N. and Rahman, R. 2013. Text Book of Inorganic Chemistry. Caravan Book House Pakistan.
6. Maeder, M. and Neuhold, Y-M. 2007. Practical Data Analysis in Chemistry. Elsevier UK.

Paper-C: Organic Chemistry 15 Marks

Organic Chemistry:

1. Identification of organic compounds containing only one functional group with special emphasis on compounds containing following functional groups. -COOH, - OH, C=0, -NH2, and -CONH2
2. Preparation and techniques of purification of 2,4,6- tribromophenol, nitrobenzene, aspirin, benzoic acid ethyl benzoate, butyl chloride, acetanilide.
3. Volumetric determination of molecular weight of a carboxylic acid.
4. Volumetric determination number of amino groups and molecules of glucose in a solution.

Recommended Books:

1. Vogel, A. I. 1966. Elementary Practical Organic Chemistry. Pearson Education Limited India.
2. Vishnoi, N. K. 2008. Advanced Practical Organic Chemistry. UBS Publishers (2nd Ed) India.
3. Barnett, E. B. and Thorne, P. C. L. 1921. Organic Analysis. Science USA.
4. Openshaw. 1976. A Laboratory Manual of Qualitative Organic Analysis. University Printing House (3rd Ed) UK.

Paper-D:Applied Chemistry **15 Marks**

1. Preparation of standard molar, normal, molal and percentage, ppm and ppb solutions,
2. Standardization of secondary standard acids and bases by volumetric method and calculation of standard deviation.
3. Preparation of Arsenious sulfide (As_2S_3) and ferric hydroxide ($Fe(OH)_3$) sol.
4. Purification of substances using common ion effect.
5. Synthesis of Ferric alum, Potassium tri-oxalato aluminate, Sodium thiosulfate and Ammonium copper (II) sulphate.
6. Determination of %age purity of HCl by Mohr's method.
7. Determination of silver in the given sample, using KSCN or NH_4SCN by Mohr's method.
8. Preparation of Potassium tri-oxalato aluminate and Ammonium Copper (II) Sulphate,
9. Separation of Benzoic acid from Sodium benzoate by solvent extraction.
10. Determination of Naphthalene, Iodine etc. by Sublimation.

Recommended Books:

1. Bhatti H. N. and Z. H. Farooqi. 2014. Physical Chemistry Laboratory Manual for B.Sc. Students. Caravan Book House (Revised Ed.) Pakistan.
2. Maeder, M. and Neuhold, Y-M. 2007. Practical Data Analysis in Chemistry. Elsevier UK.
3. Vogel, A. I. A. 1995. Text Book of Macro and Semi micro Qualitative Inorganic Analysis, Longamn Green & Co England.
4. Skoog, D. A.; West, D. M. and. Holler, F. J. 1994. Analytical Chemistry. Saunders College Publications (6th Ed).
5. Bhatti, H. N. and Rahman, R. 2013. Text Book of Inorganic Chemistry. Caravan Book House Pakistan.