

7. Chemistry

B.Sc. Chemistry-II

Total Mark: 100

Appendix 'A'

(Outlines of Tests)

Paper-A:	Organic Chemistry (Written)	:	40 Marks
Paper-B:	Applied Chemistry (Written)	:	40 Marks
Paper-C:	Lab-II (Organic Chemistry & Applied Chemistry) (Practical)	:	10+10=20 Marks

Appendix 'B'

(Syllabi and Courses of Reading)

Paper-A: Organic Chemistry

40 Marks

It is compulsory to attempt at least 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, bicycloalkanes, 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 cycloalkanes by Freund synthesis, Hydrogenation of cyclic alkenes, 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 Saytzeff 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 aromaticity, Natural sources of aromatic hydrocarbons, Preparation 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.

Polycyclic aromatic hydrocarbons, naphthalene, anthracene and phenanthrene, 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 Saytzeff 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-II

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 aldehydes and ketones, Nucleophilic additions of water, alcohols, ammonia and its derivatives, hydrogen cyanide, bisulfite, reduction and oxidation reactions, Aldol condensation and related reactions, Cannizzaro's reaction, Wittig reaction, oxidation reactions, Chemical tests of aldehydes and ketones.

7. CHEMISTRY OF CARBOXYLIC ACIDS AND THEIR DERIVATIVES

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 α -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.

It is compulsory to attempt at least 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 quaternary 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: Lab-II (Organic Chemistry & Applied Chemistry) 20 Marks

Organic Chemistry: 10 Marks

1. Identification of organic compounds containing only one functional group with special emphasis on compounds containing following functional groups. -COOH, - OH, C=O, -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.

Applied Chemistry:**10 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.