University of Sargodha B.Sc Chemistry (Elective) Syllabus

B.Sc CHEMISTRY (ELECTIVE)

Marks

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<th>Paper “A”</th>
<th>Physical Chemistry</th>
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<td>Paper “B”</td>
<td>Inorganic Chemistry (Written)</td>
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Practical: (For three Days, Four Hours Duration each day as detailed below):

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<th>Paper “A”</th>
<th>Physical Chemistry (Practical)</th>
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<td>Paper “B”</td>
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Total: 200

SYLLABUS FOR B.Sc. (Chemistry) Course

PAPER A: PHYSICAL CHEMISTRY (Written) 50 marks

Note. All units should be expressed in SI System.
• **STATES OF MATTER**

**Gases:**

Ideal gas laws and general gas equation, Kinetic molecular theory of gases, Kinetic equation for ideal gases and deduction of gas laws, molecular velocities (Averages, root mean square and most probable), distribution of molecular velocities and experimental verification, molecular collisions, mean free path, collision frequency, heat capacity of gases (Cp,Cv).

**Thermal Energy:**


**Liquids:**

Structural differences between gases and liquids, Vapour pressure, surface tension, viscosity, refractive index, optical activity and dipole moment (their measurements and relation to chemical constitution).

**Solids:**

Crystal lattice and unit cell, law of crystallography, crystal system. X-rays diffraction and the Bragg’s equation. Experimental methods for X ray structure determination. Closed-packed sphere structures, structure of ionic solids, Elementary treatment of metals, insulators and semiconductors.

**Colloids:**

Classification, preparation, purification and properties of colloidal solutions, Brief treatment of Gels, Emulsions, Aerosols and Surface – active agents.

• **SOLUTIONS:**

Raoults law, Henry’s law, activity and activity coefficients, Deviations of solutions from ideal behaviour. Colligative properties, lowering of vapour pressure, Boiling point elevation, Depression in freezing point and osmotic pressure (Their measurements and thermodynamic derivation of molecular masses). Abnormal colligative properties of solutions.

**ATOMIC AND MOLECULAR STRUCTURE**

Earlier developments, Nature of light radiations, Bohr’s theory of atomic structure. Interpretation of emission spectra of hydrogen atoms. Quantum mechanics, de Broglie equation
and Eigen values. Interpretation of (H-E). Eigen function and Eigen values. Heisenberg’s uncertainty principle. Particles in one dimensional box (permitted energies and values).

Quantum number of atomic orbitals, Pauli’s Exclusion Principle. Distribution of electrons in atomic orbitals.

Chemical Bonding (Elementary treatment of Lewis, Valence bond and Molecular orbital theories).

- **THEORMODYNAMICS:**

  Thermodynamics terms and types of system. State and state function. Equilibrium states, nature of heat and work, Sign convention and units of work and q. Internal energy change, first law of the thermodynamics, enthalpy. Heat capacity $C_p - C_v - R$.


- **CHEMICAL EQUILBRIUM:**

  Basic concepts, law of mass action, Relationship between $K_c$, $K_p$, $K_x$ and $K_n$ for gaseous reactions. Homogeneous gaseous equilibria. Effects of pressure, concentration on equilibrium changes. Examples of chemical equilibria. Degree of dissociation.

  Le Chatelier’s Principle and its applications to homogeneous and heterogeneous equilibria, thermodynamic equations. Effect of temperature on chemical equilibrium.

- **PHASE REQUILIBRIUM:**

  Phases, components, degrees of freedom. Gibb’s phase rule and its derivation. Phase diagram, One component system, (Water and sulphur system). Two component systems, eutectic systems, cooling curves and cooling behaviour, silver-lead system, Compound formation with congruent m.p. Ferric chloride- water system, sodium sulphate- water system.
Solid solution and alloy systems, liquid-vapour systems. Three component systems. Partially miscible a three component systems. Liquid-liquid systems, Nernst’s distribution law, applications and deviations.

- **CHEMICAL KINETCS:**

The reaction rate (average and instantaneous). Rate equation, velocity constant. Rate law expression, order and molecularity. Kinetic expressions for zero order, first order, pseudo-unimolecular and second order (with same 8 different initial conc.) with examples. Determination of order and rate const of a reaction. Effect of temperature. Activation energy and its determination.

Biomolecular collison theory of reaction rates (causes of its failure). Collision theory of unimolecular reactions (Lindemann’s mechanism). Some examples of m/re-action mechanisms.

- **ELECTROCHEMISTRY:**


- **NUCLEAR CHEMISTY:**


**Paper ‘A’**

**PHYSICAL CHEMISTRY (PRACTICALS)**

**Marks** 16

**Surface Tension Measurements:**

Determination of surface tension of different liquids. Parachor values. Composition of mixtures of two miscible liquids.

- **Viscosity Measurements:**

Determination of viscosity coefficients of different liquids. Rheochor values and composition of mixture of two miscible liquids.
• **Refractometry:**

Determination of specific and molar refractivities of different liquids, composition of two miscible liquids.

• **Thermochemical Measurements:**

  (i) Heat of neutralization of acids and bases.
  (ii) Heat of solution of different salts.

• **Molecular Mass:**

Determination by ebullioscopic method.

• **Chemical Kinetics:**

Determination of reaction rate constant for a first order reaction (acid hydrolysis).

• **Conductance Measurement:**

  (i) Determination of cell constant and molar conductance.
  (ii) Verification of Ostwald’s dilution law. Determination of degree of dissociation for weak electrolytes.

**RECOMMENDED BOOKS**

- Text Book of Physical Chemistry for B.Sc students by G. Nabi, Publishers; Ilmi Kitab Khana, Urdu Bazar, Lahore.
- Akhtar M.N. & Ghulam Nabi ,”Text Book of Physical Chemistry”
SYLLABUS B.Sc

PAPER B: INORGANIC CHEMISTRY (WRITTEN) 50 Marks

Atomic Structure and periodic Table:

Electromagnetic radiations, Atomic spectra, the wave nature of electron, electron spin and the Pauli’s exclusion Principle, the special distribution of electrons, the electronic configuration of elements. The variation of properties with atomic structure, atomic size, ionization energy, electron affinities and electronegativities. Modern trends in periodic table based upon chemical re-activities of elements.

Metals as reducing agents and non-metals as oxidizing agents. Redox actions, redox potential (elementary treatment). Electrochemical series and its applications.

- Chemical Bonding:


- Acid-Base Equilibria in Aqueous Solutions:


- Ionic Reaction in six Solution:

Hydrolysis of salts, applications of law of mass action and the principle of solubility product and common ion effect in inorganic qualitative analysis.

- Chemistry of p-block Elements:

General characteristics of the following groups of p-block elements with reference to the aspects given against each.

- Boron and Aluminum:
Gradation of the characteristic properties within group III. Metallurgy of aluminium and its chemical characteristics. Electron deficient molecules such as boranes aluminium hydrides and halides, including their structure bonding. Boric acid, borax and alums.

- **Carbon and Silicon:**


- **Nitrogen and Phosphorus:**

Gradation of the characteristics properties within group V. Oxides and oxyacids of nitrogen and their role in environmental pollution. Nitrogen and phosphorus based fertilizers.

- **Oxygen and Sulphur:**

Gradation of the characteristics properties within group VI. Oxides and Oxyacids of sulphur. Role of sulphur dioxide in air pollution. Thionic acids. Use of “hypo” in photography.

- **Halogens:**

Gradation of the characteristic properties within group VII. Oxyacids of chlorine. Structural and chemical aspects of interhalogens and pseudohalogens.

- **Zero Group Elements:**

Basis of reactivity of noble gases. Nature of bonding and structure of xenon compounds (fluorides, oxides and oxyfluorides), laboratory and commercial utilization of noble gases.

- **Transition Elements (d-block elements):**

General characteristics of d-block elements, Electronic configuration, coordinate bond formation, Development of coordination compounds, nomenclature. Applications of valence bond, crystal field theories to explain the structures of coordination compounds. Colour and magnetic behaviour of coordination compounds.

- **Modern Materials:**

Introduction to liquid crystals, inorganic polymers, engineering ceramics, fiber glass, thin films and semiconductors.
Qualitative Analysis:

1. Mixture of four radicals (cations and anions) from standard samples as well as from water, soil and simple ores by semi-micro techniques/macro-techniques.

1. Spot tests for the following cations:

Ni (II), Ag (i) Hg (II) Cd (II)

- Separation of cations:-

Ni (II), Co (II), Mn (II), Cu (II), by paper chromatography

- Quantitative Analysis:-

(Calculations should be based on morality). Multistage exercises based on iodometry, iodometry, complexometry and redox reactions, e.g.,

7. Preparation of Ferrous Sulphate from Kipp’s Waste and determining the percentage purity of the sample by estimating Fe (II) with K₂Cr₂O₇.

1. Preparations of CuZo₄, from copper turnings and determining parity of the sample by Iodometry and Iodimetry.

- Determinations of hardness of water using EDTA and other relevant exercises.

- Gravimetric Analysis:-

Estimations of Ba⁺² and Pb⁺² ions as BaSO₄ and as PbCrO₄

RECOMMENDED BOOKS (INORGANIC CHEMISTRY)

- Text Books of Inorganic Chemistry (for B.Sc students) by Muhammad Zafar Iqbal, Ilmi Kitab Khana, Lahore.


Paper ‘C’ ORGANIC CHEMISTRY (WRITTEN) Marks 50

1- Basic Concepts:

Atomic, molecular and hybrid orbitals: multiple localized and delocalized bonds; properties of bonds; inductive effect; dipole moment. The concept of resonance, rules for resonance; resonance energy; steric inhibition of resonance; hyperson jugation; resonance effect; hydrogen bonding; automerism. Introduction to resonance, rules for resonance, resonance energy, steric inhibition of resonance, Introduction to spectroscopy with special reference to ultraviolete / visible and infrared spectroscopy.

2- Hydrocarbons:


3- Stereoisomerism:

Conformational Analysis of ethane and butane.

Optical Isomerism. Optical activity, chiral carbon atom and optical isomerism; relative and absolute configuration, creation of chiral carbon and racemization, optical isomerism in compounds containing two chiral carbon atoms; diasteroisomers; elements of symmetry; resolution of racemic mixture.

Geometrical Isomerism, cis / trans isomerism, designation of configuration, Determination of configuration.
4- **Alkyl Halides:**

Nomenclature, methods of preparation and chemical reactions with special reference to nucleophilic substitution and elimination reaction of alkyl halides. Preparations, structure and synthetic applications of Grignards reagents.

5- **The Hydroxyl group and Ethers:**

Nature of hydroxyl group in alcohols and phenols

*Alcohols:* Classification and nomenclature of alcohols; methods of preparation and chemical reactions of alcohols; distinction between primary, secondary and tertiary alcohols. Polyhydric alcohols.

Phenols: Methods of preparation of phenols; acidity of phenols; chemical reactions of phenols.

Ethers: Methods of preparation and reactions of ethers.

6- **The Carbonyl Group:**

Nature of carbonyl group and its reactivity; nomenclature of aldehydes and ketones; methods of preparation of aldehydes and ketones; chemical reactions of aldehydes and ketones; distinction between aldehydes and ketones.

7- **Carboxylic Acids and their Derivatives:**

Nomenclature of carboxylic acids; methods of preparation and chemical reactions of carboxylic acids, strength of carboxylic acids and the factors affecting it. Formation and hydrolysis of acid anhydrides, acid amides, acid halides and esters including glycerides. Introduction to aminoacids.

8- **Nitrogen Compounds:**

*Amines:* Classification and nomenclature of amines; methods of preparation and chemical reactions of amines; distinction between primary, secondary and tertiary amines. Preparation and reactions of aniline. Basicity of aliphatic and aromatic amines and factors affecting it.

Siazonturn Salts and their synthetic applications.

**Heterocyclic Compounds:** Methods of preparation of pyrrole and pyridine; aromatic character of pyrrole and pyridine and comparison of their reactivity with benzene. Some of the important reactions of pyrrole and pyridine.

9- **Carbohydrates:**
Classification of carbohydrates, characteristic features of mono-, di- and polysaccharides and some of their important reactions. Structure of ring size and conformation of glucose.

Paper ‘C’

Organic Chemistry (Practicals):

Marks 17

- Identification of organic compounds containing only one emphasis on compounds containing the following functional group with special emphasis on compounds containing the – COOH, OH, CO, NH₂, and CONH₂.
- Basic experimental techniques used in organic chemistry.
  1. Simple and fractional distillation.
  2. Solvent extraction.
  3. Sublimation
  4. Recrystallization
- Organic Preparation:
  1. Preparation of tribromophenol (Halogenations)
  2. Preparation of nitrobenzene (Nitration)
  3. Preparation of aspirin (Acetylation)
  4. Preparation of ethyl Benzoate (Esterification)
  5. Preparation of benzoic acid from toluene (Oxidation of side chain)

RECOMMENDED BOOKS (ORGANIC CHEMISTRY)
