7. Chemistry

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

Appendix 'A'

(Outlines of Tests)

Paper-A:	Physical Chemistry (Written)	:	40 Marks
Paper-B:	Inorganic Chemistry (Written)	:	40 Marks
Paper-C:	Lab-I (Physical Chemistry & Inorganic Chemistry) (Practical)	:	10+10=20 Marks

Appendix 'B'

(Syllabi and Courses of Reading)

Paper-A: Physical Chemistry **40 Marks**

It is compulsory to attempt at least Two Questions from Each Section. It is also compulsory to attempt question from Chapter 4 "Basic Mathematics for Chemistry".

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, 2nd 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 40 Marks

It is compulsory to attempt at least 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: Lab-I (Physical Chemistry & Inorganic Chemistry) 20 Marks

Physical Chemistry: 10 Marks

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.

Inorganic Chemistry: **10 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.