PUNJABI UNIVERSITY, PATIALA
(Established Under Punjab Act. No. 35 of 1961)

ORDINANCES
AND
OUTLETS OF TESTS,
SYLLABUS AND COURSES OF READING
FOR B.SC. (CHEMISTRY) PART-I
SESSION 2020-21, 2021-22 & 2022-23

B.Sc. (Chemistry) Part-I
2020-21, 2021-22 & 2022-23

SEMESTER I

Paper	Title	Max. Marks	Sem. Paper	Int. Asstt.
I	INORGANIC CHEMISTRY	35	26	09
II	ORGANIC CHEMISTRY	35	26	09
III	PHYSICAL CHEMISTRY	35	26	09
I	PRACTICAL CHEMISTRY	45	16 (Pass Marks)	

SEMESTER II

Paper	Title	Max. Marks	Sem. Paper	Int. Asstt.
I	INORGANIC CHEMISTRY	35	26	09
II	ORGANIC CHEMISTRY	35	26	09
III	PHYSICAL CHEMISTRY	35	26	09
II	PRACTICAL CHEMISTRY	45	16 (Pass Marks)	

Drug Abuse Problem, Management and Prevention* **100 (MM)** **70 (SP)** **30(IA)**
Qualifying Paper: Session 2016-17, 2017-18 and 2018-19
*As per University Letter No.13831/SM-6 Dated: 12.10.2016

PAPER-I
INORGANIC CHEMISTRY

Max Marks : 35 **30 hours**
Semester Paper : 26 **Time allowed - 3 hrs**
Internal Assessment: 9 **3 period/week**
Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 4 marks each. Section C will consist of 5 short answer questions that will cover the entire syllabus and will be of 2 marks each. Use of scientific non-programmable calculator is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions (Section C 9th question being compulsory) selecting two questions from each of A & B Sections.

Section - A

1. Atomic Structure 7 hrs

Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of, Ψ and , Ψ^2, quantum numbers, radial and angular wave functions and probability distribution curve, shapes of s, p, d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements and ions.

2. Periodic Properties 5 hrs.

Position of element in the periodic table effective nuclear charge and its calculations. Atomic and ionic radii, ionization energy, electronic affinity and electronegativity-definition, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behavious.

3. Chemistry of Noble gases 3 hrs.

Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.

Section - B

1. Chemical Bonding - I 15 hrs.

Covalent Bond-Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. BeF_2 , BF_3 , CH_4, PF_5, SF_6, IF_7, $SnCl_2$, XeF_4, BF_4^-, PF_6^-, $SnCl_6^{2-}$.

2. Chemical Bonding - II

Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, CIF_3, ICI_2, and H_2O. MO theory, homonuclear (elements and ions of 1st and 2nd row), and heteronuclear (BO, CN, CO^+, NO^+, CO, CN), diatomic molecules, multicenter bonding in electron deficient molecule (Boranes) percentage ionic character from dipole moment and eIectronegativity difference.

SEMESTER I
PAPER-II
ORGANIC CHEMISTRY

Max Marks : 35 **30 hours**
Semester Paper : 26 **Time allowed - 3 hrs**
Internal Assessment: 9 **3 period/week**
Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 4 marks each. Section C will consist of 5 short answer questions that will cover the entire syllabus and will be of 2 marks each. Use of scientific non-programmable calculator is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions (Section C 9th question being compulsory) selecting two questions from each of A & B Sections.

Section - A

I. Structure and Bonding 5 Hrs.

Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, Van der Walls interactions, resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding.

II . Mechanism of Organic Reactions 7 Hrs

Curved arrow notation, drawing electron movements with half- headed and double headed arrows, homolytic and heterolytic bond breaking. Types of reagents of organic reaction. Energy considerations. Reactive intermediates-bocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal charges on intermediates and other ionic species.

Methods of determination of reaction mechanism (product analysis, intermediates, isotope effect, kinetic and stereo-chemical studies).

III. Alkanes 4 Hrs.

Isomerism in alkanes, sources, methods offormation (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties and Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.

Section – B

1. Cyclo alkanes 3 Hrs.

Cycloalkanes--nomenclature, chemical reactions, Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strain less rings. The case of cyclopropane ring: banana bonds.

2. Alkcnes, Cycloalkenes 6 Hrs.

Nomenclature of alkenes-methods of formation, mechanisms and dehydration of alcohols and dehydrohalogenation of alkyl halides regioselectivity in alcohol dehydration. The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes-mechanisms involved in hydrogenation, electrophilic and free radical additions Markownikoff's rule, hydroboration-oxidation, oxymercuration reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$. Polymerization ofalkenes. Substitution and the allylic and vinylic positions of alkenes. Industrial application of ethylene and propene.

Methods of formation, conformation and chemical reactions of Cycloalkenes.

3. Dienes And Alkynes 6 Hrs.

Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerization. Chemical reactions-I,2 and l,4 additions, Diels-Alder reaction.

Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidityn of alkynes. Mechanism of electrophilic and nucleophilic addition reactions hydroboration-oxidation. metal-ammonia reductions, oxidation and polymerization.

SEMESTER I
PAPER-III
PHYSICAL CHEMISTRY

Max Marks : 35 **30 hours**
Semester Paper : 26 **Time allowed - 3 hrs**
Internal Assessment: 9 **3 period/week**
Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 4 marks each. Section C will consist of 5 short answer questions that will cover the entire syllabus and will be of 2 marks each. Use of scientific non-programmable calculator is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions (Section C 9th question being compulsory) selecting two questions from each of A & B Sections.

Section - A

1. **Mathematical Concepts** 8 Hrs.

Logarithmic relations. curve sketching, linear graphs and calculation of slopes, differentiation of functions like kx, e^x, x^n, sin x, log x, maxima and minima, partial differentiation and reciprocity relations. Integration of some useful/relevant functions permutations and combinations. Factorials. Probability .

2. **Evaluation of Analytical Data** 6 Hrs.

Terms of mean and median, precision and accuracy in chemical analysis, determining accuracy of methods, improving accuracy of analysis, data treatment for series involving relatively few measurements, linear least squares curve fitting, types of errors, standard deviation, confidence limits, rejection of measurements (F-test and Q-test) numerical problems related to evaluation of analytical data.

Section - B

3. **Liquid State** 4 Hrs.

Intermolecular forces, structure of liquids (a qualitative description) Structural differences between solids, liquids and gases.

Liquid crystals: Difference between liquid crystal, solid and liquid, Classification, structure of nematic and eholestric phases. Thermography and seven segment cell.

4. **Gaseous State** 8 Hrs

Postulates of kinetic theory of gases, deviation from ideal behaviour, van der Waals equation of states, the isotherms of van der Waals equation, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of state.

Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision

number, mean free path and collision diameter, Liquifacation of gases (based on Joule-Thomson effect).

5. **Physical Properties and Molecular Structure** 4 Hrs.

Optical activity, polarization-(Clausius-Mossotti equation), orientation of dipoles in an electric field, dipole moment. Induced dipole moment, measurement of dipole moment temperature method and refractivity method. Dipole moment and structure of molecules, magnetic properties-paramagnetism, diamagnetism and ferromagnetism.

PRACTICAL CHEMISTRY - I
SEMESTER I

Max Marks : 45 6 Periods / week
Passing Marks : 35%

INSTRUCTIONS FOR THE
PAPER SETTERS EXAMINERS/CANDIDATES

The Practical Examinations will be held in morning (one day) and morning session will be of 3 hours duration. During this session students will perform semi micro analysis. Paper setter will enlist five different mixtures and the examiner will randomly distribute these mixtures amongst the students. Each candidate will analyse one mixture. Students are permitted to consult the books for the scheme of tests for semimicro analysis. Examiners will check the note books and will hold viva-voce.

INORGANIC CHEMISTRY
Semi-micro analysis:

Cation analysis, separation and identification of ions from Groups I, II, III, IV, V and VI. Anion analysis (2 cation and 2 anion with no interference). 30 Marks

Viva Voce 10 Marks

Copy 5 Marks

SEMESTER II
PAPER-I
INORGANIC CHEMISTRY

Max Marks : 35 **30 hours**
Semester Paper : 26 **Time allowed - 3 hrs**
Internal Assessment: 9 **3 period/week**
Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 4 marks each. Section C will consist of 5 short answer questions that will cover the entire syllabus and will be of 2 marks each. Use of scientific non-programmable calculator is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions (Section C 9th question being compulsory) selecting two questions from each of A & B Sections.

Section - A

1. Ionic Solids- 5 hrs.

Concept of close packing, Ionic structures, (NaCl type, Zinc blende, Wurzite, CaF_2 , and antifluorite), radius ratio rule and coordination number, Limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond-free electron, valence bond and bond theories.

2. s-Block Elements 5 hrs.

Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems.

3. p - Block Elements (Group 13) 5 hrs.

Comparative study (including diagonal relationship) of groups 13 elements, compounds like hydrides, oxides, oxyacids and halides of groups 13; hydrides of boron-diborane and higher boranes, borazine, borohydrides.

Section - B

4. p - Block Elements (Group 14-17) 15 hrs.

Comparative study (including diagonal relationship) of groups 14-l7 elements, compounds like hydrides, oxides, oxyacids and halides of groups 14-17; fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides.

SEMESTER II
PAPER-II
ORGANIC CHEMISTRY

Max Marks : 35 **30 hours**
Semester Paper : 26 **Time allowed - 3 hrs**
Internal Assessment: 9 **3 period/week**
Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 4 marks each. Section C will consist of 5 short answer questions that will cover the entire syllabus and will be of 2 marks each. Use of scientific non-programmable calculator is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions (Section C 9th question being compulsory) selecting two questions from each of A & B Sections.

Section - A

1. Stereochemistry of Organic Compounds 15 Hrs.

Concept of isomerism. Types of isomerism

Optical isomerisin-elements of symmetry, molecular chirality, enantiomers, stereogenic centrec, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization.

Relative and absolute configuration, sequence rules, D & Land R & S systems of nomenclature.

Geometric isomerism-determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.

Conformational isomerism-conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives.

Newman projection and Sawhorse formulae, Fischer and flying wedge formulae.

Difference between configuration and conformation.

Section - B

1. Arcncs and Aromaticity 7 Hrs.

Nomenclature of benzene derivatives. Aromatic nucleus and side chain. Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture.

Aromaticity: the Huckel rule, aromatic ions.

Aromatic electrophilic substitution-general pattern of the mechanism, role of σ and π complexes. Mechanism or nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives.

Methods of formation and chemical reaction of alkylbenzenes alkynyl benzenes.

2. Alkyl and aryl halides 8 Hrs.

Nomenclature and classes of alkyl halides, methods of formation chemical reactions. Mechanisms of nucleophilic substitution reactions of alkyl halides, S_N^1 and S_N^2 reactions with energy profile diagrams.

Methods of formation of aryl halides, nuclear and side chain reactions. The addition elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions.

Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides.

SEMESTER II
PAPER-III
PHYSICAL CHEMISTRY

Max Marks : 35 **30 hours**
Semester Paper : 26 **Time allowed - 3 hrs**
Internal Assessment: 9 **3 period/week**
Pass Marks : 35%

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 4 marks each. Section C will consist of 5 short answer questions that will cover the entire syllabus and will be of 2 marks each. Use of scientific non-programmable calculator is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions (Section C 9th question being compulsory) selecting two questions from each of A & B Sections.

Section - A

1. **Solutions, Dilute Solutions and Colligative Properties** 8 Hrs.

Ideal and non-ideal solutions, methods of expressing concentration of solutions, activity and activity coefficients.

Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination molecular weight from osmotic pressure,

Elevation of boiling point and depression of freezing point, Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties.

Abnormal molar mass, degree of dissociation and association of solutes.

2. **Colloidal State** 7 Hrs.

Definition of colloids, classification of colloids

Solids in liquids (sols): properties-kinetic, optical and electrical; stability of colloids protective action, Hardy-Schulze law, gold number.

Liquids in liquids (emulsions) types of emulsions, preparation, Emulsifiers.

Liquids in solids (gels): Classification, preparation and properties inhibition. General applications of colloids.

Section – B

3. Chemical Kinetics and catalysis 15 Hrs.

Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction- concentration, temperature, pressure, solvent, light, catalyst. Concentration dependence of rates, mathematical characteristics of simple chemical reactions-zero order, first order, second order, pseudo order, half life and mean life. Determination of the order of reaction-s-differential method, method of integration, method of half life period and isolation method.

Radioactive decay as a first order phenomenon.

Theories of chemical kinetics, effect of temperature on rate of reaction. Arrhenius equation, concept of activation energy.

Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects.

Catalysis and general characteristics of catalytic reactions. Homogeneous catalysis, acid base catalysis and enzyme catalysis including their mechanisms, Michaelis Menten equation for enzyme catalysis and its mechanism.

PRACTICAL CHEMISTRY II
SEMESTER II

Max Marks : 45 6 Periods / week
Passing Marks : 35%

INSTRUCTIONS FOR THE
PAPER SETTERS EXAMINERS/CANDIDATES

In this session in morning students will perform physical and organic chemistry practicals. Examiner will again conduct viva-voce of students.

1) The examiner should preferably give different liquids solids to the candidates for the determination of boiling point/melting point and crystallization from the list of liquids/solids by the paper setter.
2) The paper setter will provide a list of five physical chemistry experiments. The examiner will allot one experiment randomly to each candidate. The candidate will write theory, brief procedure and

general calculations of the experiment in the first 10 minutes and thereafter perform the actual experiment.

DETAILS OF DISTRIBUTION OF MARKS

1) Melting point/boiling point/crystallization 10 marks
2) Physical chemistry experiment 20 marks
   a) Initial write up 7 marks
   b) Performance 18 marks
4) Viva-voce 10 marks
5) Note Book 5 marks

Laboratory Techniques

Determination of melting points:

Naphthalene, 80-82^{o}. Benzoic acid, 121.5-122^{o}
Urea, 132.5-133^{o}, Succinic acid, 184.5-185^{o}.
Cinnamic acid, 132.5-133^{o}, Salicylic acid, 157.5-158^{o}.
Acetanilide, 113.5-114^{o}, *m*-Dinitrobenzene, 90^{o}.
p-Dichlorobenzene, 52^{o}, Asprin, 135^{o}.

Determination of boiling points

Ethanol, 78^{o}, Cyclohexane, 81.4^{o}. Tolune, 110.6^{o}, Benzene, 80^{o}.

Crystallization

Concept of induction of crystallization
Phthalic acid from hot water (using fluted filter paper and seamless funnel)
Acetanilide from boiling water
Naphthalene from ethanol
Benzoic acid from water

Physical Chemistry Experiment 20 Marks

Chemical Kinetics

1. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at room temperature.
2. To study the effect of acid strength on the hydrolysis of an ester.
3. Viscosity & Surface Tension of pure liquids.
   To determine the viscosity and surface tension of C_2H_5OH and glycerin solution in water
4. Molecular weight determined by Rast method.

Viva Voce 10 Marks
Copy 5 Marks

BOOKS SUGGESTED (THEORY COURSES)

1. *Basic Inorganic Chemistry.* F.A. Cotten. G. Wilkinson and P.L.. Gaus. Wiley.
2. *Concise Inorganic Chemistry.* J. D. Lee. ELBS.

3. *Concepts of Models of Inorganic Chemistry.* B. Doaglas. D. McDaniel and 1. Alexander, John Wiley.
4. *Inorganic Chemistry.* D.E. Shriver, P. W. Aikins and C.H. Langford. <Oxford.
5. *Inorganic Chemistry.* W. W. Porterfield Addison. Wesley.
6. *Inorganic Chemistry.* A.G. Sharpe, ELBS.
7. *Inorganic Chemistry.* G.L. Miessler and O.A. Tarr, Prentice Hall.
8. *Organic Chemistry.* Morrison and Boyd, Prentice Hall.
9. *Organic Chemistry.* L.G. Wade lr.Prentice Hall.
10. *Fundamentals of Organic Chemistry.* Solomons, John Wiley.
11. *Organic Chemistry.* Vol. I, II & III. S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International)
12. *Organic Chemistry.* F.A. Aarey, McGraw Hill India.
13. *Introduction to Organic Chemistry.* Stretwieser, Heathcock and Kosover, Machmilan.
14. *Physical Chemistry.* G.M. Barrow, International Student Edition. McGraw Hill.
15. *Basic Programming with Application.* V.K. Jain, 1'ata McGraw Hill.
16. *Computers and Common. Sense.* B. Ryal and Shely, Prentice Hall.
17. *University General Chemistry.* C.N.B. Rao. Macmillan.
18. *Physical Chemistry.* R.A. Alberty, Wiley Eastern Ltd.
19. *The Elements of Physical Chemistry,* P.w. Aikins, Oxford.
20. *Physical Chemistry Through Problems.* S.K. Dogra and S. Dogra. Wiley Eastern Ltd.

BOOKS SUGGESTED (LABORATORY COURSES)

I. *Vogel's Qualitative Inorganic Analysis,* revised, Svehla, Orient Longman.
2. *Vogel's Textbook of Quantitative Inorganic Analysis* (revised), J. Basseff, R.C. Dennery, G.H. Jeffery and J. Mendham, ELBS.
3. *Standard Methods of Chemical Analysis,* W.w. Scott the Technical Press.
4. *Experimental Inorganic Chemistry:* W.G. Palmer, Cambridge.
5. *Handbook of Preparative Inorganic Chemistry.* Vol. I & II, Brauer, Academic Press.
6. *Inorganic Synthesis,* McGraw Hill.
7. *Experimental Organic Chemistry.* Vol. I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai, Tata McGraw Hill.
8. *Laboratory Manual in Organic Chemistry.* R.K. Bansal, Wiley Eastern.'
9. *Vogel's Textbook 0/ Practical Organic Chemistry.* B.S. Furniss, A.1. Harnaford, V. ogers, P.w.G. Smith and A.R. Tatchell, ELBS. -.
10. *Experiments in General Chemistry.* C.N.R. Rao and U.e. Aggarwal. East- West Press.
11. *Experiments in Physical Chemistry.* R.C. Dass and B. Behra, Tata McGraw Hill.
12. *Advanced Practical PhysicalChemistry,* J.B. Yadav, Goel Publishing House.
13. *Advanced Experimental Chemistry.* Vol. I : Physical, J.N. Gurtu and R. Kapoor, S. Chand & CO.
14. *Selected Experiments in Physical Chemistry,* N.G. Mukherjee, J.N. Ghose & Sons.
15. *Experiments in Physical Chemistry.* J.E. Ghosh, Bharati Bhavan.