Syllabus for B.Sc (Chemistry) to be started from June-2013
First Semester
PAPER B. Sc. - CHEM-101
INORGANIC CHEMISTRY

Max.Marks: 50
Credit - 3

Note for Examiners and Students:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one parts. Section E will be of 18 marks and consists of TEN objective type questions (in MCQ/true and false / fill in the blanks)of one mark each and FOUR short answer questions of two marks each covering the entire paper.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION –A (11 Hrs)

Atomic Structure:

Dual nature of electron, Heisenberg’s uncertainty principle, orbitals, Schrödinger wave equation, quantum numbers, orbital wave function, probability distribution curves, shapes of s, p, d and f orbital, Pauli’s exclusion principle, Hund’s rule of maximum multiplicity. Effective nuclear charge and screening effect, Slater’s rule and its applications, energy level diagrams of multi electron system

SECTION –B (11 Hrs)

Periodic Table and Periodic Properties:


SECTION-C (12 Hrs)

Chemical Bonding-I:

Covalent bond- valence bond theory and its limitations, various types of hybridization and shapes of simple molecules and ions (BeF₂, BF₃, CH₄, PF₅, SF₆, IF₇, SnCl₂, XeF₄, BF₄⁻, PF₆⁻, SnCl₆²⁻). Molecular orbital approach of bonding (LCAO method) symmetry and overlap symmetry of molecular orbital, bonding in homonuclear molecules (H₂, Be₂, N₂, N₂⁺, O₂, O₂⁻, O₂¹⁻O₂²⁻ and Ne₂) and hetero nuclear molecules (NO, CO, CN and their ions, HF & HCl).
SECTION-D (11 Hrs)

Chemical Bonding-II:

Ionic solids- concept of close packing, radius ratio rule and coordination numbers, limitation of radius ratio rule, lattice defects, Structures of NaCl, CsCl, ZnS. Lattice energy, Born Haber cycle. Polarising power, polarisability and Fajan’s rules, percent ionic character of polar covalent bond, dipole moment and structure of molecules.

Hydrogen Bonding and Vander Waals forces:

Hydrogen bonding – definition, types, effects of hydrogen bonding on properties of substance, applications. Brief discussion of various types of Vander Waals forces.

Books Recommended:

1. Concise inorganic Chemistry 4th Edn. By J.D.Lee.ELBS
Note for Examiners and Students:

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SECTION- A (11 Hrs)

Structure and bonding:

Hybridization, bond length, bond energy, bond angle, localized and delocalized chemical bond, resonance, conditions of resonance, resonance effect and its applications, Electronic displacements: inductive effect, electrometric effect, mesomeric effect & hyperconjugation, cross conjugation, tautomerism.

Basic Concepts in Organic reactions:

Nature of fission of covalent bond, type of reagents: nucleophiles and electrophiles, reaction intermediates: carbocations, carbanions, free radicals, carbenes, nitrenes, and benzyynes. Types of organic reactions: addition, elimination, substitution and rearrangement reactions. Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies).

SECTION- B (11 Hrs)

Sterechemistry of Organic Compounds:

Optical isomerism – Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, meso compounds & racemic mixture and resolution of enantiomers. Relative and absolute configuration, sequence rules, D & L and R & S system of nomenclature.


Conformational isomerism--Newman projections and sawhorse formulae, Fischer and flying wedge formulae, Conformational analysis of ethane, n- butane and cyclohexane, axial and equatorial bonds, difference between configuration and conformation.
SECTION- C (11 Hrs)

Alkanes:
IUPAC nomenclature of branched and unbranched alkanes, the alkyl groups, classification of carbon atoms in alkanes. Methods of formations with reference to Wurtz reaction, Kolbe reaction, Corey house reaction and decarboxylation of carboxylic acids, physical properties and chemical reaction of alkanes, mechanism of free radical halogenations of alkanes, orientation, reactivity and selectivity.

Cycloalkanes:

SECTION-D (12 Hrs)

Alkenes and cycloalkenes:
Nomenclature of alkenes, methods of preparation of alkenes, mechanism of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rule, Hofmann elimination, physical properties and relative stability of alkenes.

Chemical reactions of alkenes:
Mechanism involved in hydrogenation, electrophilic and free radical additions Markownikoff’s rule, hydroboration- oxidation, omymercuration-reduction, ozonolysis and its applications, hydration, hydroxylation and oxidation with KMnO₄, polymerization of alkenes, Substitution at the allylic and vinylic positions of alkenes, methods of formation, conformation and chemical reactions of cycloalkenes.

Dienes:
Nomenclature and classification of dienes, isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation. Chemical reactions-1, 2 and 1, 4 additions and their mechanism, Diels-Alder reaction, polymerization.

Books Recommended:
1. Stereo Chemistry by P.S. Kalsi
2. Organic Chemistry by Paula Yurkanis Bruice.
3. Reaction Mechanism by O. P. Aggarwal.
Second Semester
PAPER B. Sc. - CHEM-203
PHYSICAL CHEMISTRY

Max.Marks: 50
Credit - 3

Note for Examiners and Students:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one parts. Section E will be of 18 marks and consists of TEN objective type questions (in MCQ/true and false / fill in the blanks) of one mark each and FOUR short answer questions of two marks each covering the entire paper.

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SECTION-A (13 Hrs)

Gaseous state:

Molecular velocities: Root mean square, average and most probable velocities. Derivation of Maxwell’s distribution law of velocities, collision number, collision frequency, mean free path and collision diameter. Postulates of kinetic theory of gases, deviation from ideal behavior, van der Waal’s equation of state.

Critical Phenomenon: P-V isotherm of real gases, continuity of state, the isotherm of van der Waal’s equation, relation between critical constants and van der Waal’s constants, the law of corresponding states, reduced equation of state. Liquefaction of gases.

SECTION-B (10 Hrs)

States of Matter:

Liquid State: Intermolecular forces, structure of liquids (a qualitative description) structural difference between solids, liquids and gases. Surface tension and viscosity: Determination, properties, Parachor, Rheochor and refractive index

Liquid Crystals: An introduction to liquid crystals. Classification and properties of liquid crystals.

SECTION-C (10 Hrs)

Solid state:

SECTION-D (12Hrs)

**Colloidal State:** Classification of colloids, solids in liquids (sols): Preparation and Properties of colloidal solutions, kinetic, optical and electrical properties. Stability of colloids, protective action, Hardy-Schulze rule and gold number.

**Emulsions:** Types of emulsions and their preparations, oils, soaps and detergents, cleansing action of soaps, CMC and its determination

**Gels:** Classification, preparation and properties, Imbibition and General applications of colloids.

**Books recommended:**

5. Surface Chemistry by Adison,L.I.Osipow.
Second Semester  
PAPER B. Sc. - CHEM-204  
INORGANIC CHEMISTRY

Max.Marks: 50 Credit - 3

Note for Examiners and Students:

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SECTION –A (14 Hrs)

Hydrogen:


S-Block Elements:

Periodic discussion and Comparative study of elements, diagonal relationship of lithium and magnesium, Lithium hydride, Lithium aluminum hydride, sodamide, alkyl and aryls of alkali metals, solvation and complexation tendencies. Role of Na\(^+\), K\(^+\), Mg\(^{2+}\) and Ca\(^{2+}\) ions in biological system, behavior of solutions in liquid ammonia.

SECTION-B (12 Hrs)

P- Block Elements:

SECTION –C (11 Hrs)

Noble Gases:

Occurrence of noble gases, History of discovery of noble gases and isolation of noble gases form air. Preparation properties and structure of important compounds of noble gases-florides, oxides, oxyflorides of xenon (valence bond structure only). Krypton difloride and clatherate compounds of noble gases.

Analytical Chemistry:

Theory of volumetric and gravimetric analysis, equivalent points, standard solutions, primary and secondary standards, end point detections, theory of titrimetry, redox and complexometric titration. Indicators, theories of indicators and their selection for volumetric analysis, important organic precipitants.

SECTION –D (8 Hrs)

Nuclear Chemistry:

Nuclear binding energy and stability, nuclear shell model, nuclear reactions – fission and fusion. Q-value, natural and artificial radioactivity.

Metallic bond and semiconductors:


Books Recommended:

2. Inorganic Chemistry by J.E.Huhhey.
5. Theoretical Inorganic Chemistry By Day & Selbin.
9. Laboratory Mannual in Organic Chemistry, R.K.Bansal
11. Essential of nuclear chemistry by H J Arnikar
12. Nuclear Chemistry by B G Harvey
13. Nuclear Chemistry by U C Dash
Third Semester
PAPER B. Sc. - CHEM-305
ORGANIC CHEMISTRY

Max.Marks: 50 Credit - 3

Note for Examiners and Students:

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2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION-A (12 Hrs.)

**Alkynes:**

Nomenclature, structure and bonding in alkynes, methods of formation, chemical reactions and acidity of alkynes, mechanism of nucleophillic and electrophilic addition reactions. Hydroboration-oxidation of alkynes, metal-ammonia reductions, oxidation and polymerization.

**Aromaticity:**

Aromaticity, Huckel rule, aromatic, antiaromatic and non aromatic compounds, aromatic ions, homoaromaticity, antiaromaticity. Annulenes.

SECTION-B (11 Hrs.)

**Arenes:**


SECTION-C (11 Hrs.)

**Alkyl and Aryl halides:**

Nomenclature and classification of alkyl halides, methods of formation, chemical reactions, mechanism of nucleophillic substitution reaction, S_N1 and S_N2 reactions with energy profile diagram. Methods of formation of aryl halides, addition-elimination and elimination-addition mechanism of nucleophillic aromatic substitution reactions. Relative reactivities of alkyl, aryl, vinyl and allyl halides. Synthesis and uses of chloroform, carbon tetrachloride, DDT and BHC.
SECTION-D (11 Hrs.)

Alcohols: Monohydric alcohols:

Classification and nomenclature, Preparation of monohydric alcohols- methods of formation by reduction of compounds containing carbonyl group, carboxylic acids and esters. Hydrogen bonding, reactions of alcohols – showing acidic nature, reactions involving C--OH and CO--H, cleavage, reactions involving both alkyl and hydroxyl groups. Distinction and inter conversion of primary, secondary and tertiary alcohols.

Dihydric alcohols:

Ethylene Glycol: preparation from alkenes, vicinal dihaloalkanes, carbonyl compounds and epoxides. Chemical reactions of vicinal glycol, oxidative cleavage by Pb[OAc]₄ and HIO₄, Pinacol- Pinacolone rearrangement .

Trihydric Alcohols:

Glycerol- preparation by saponification of oils and fats and from propylene, Chemical reactions of glycerol.

Books Recommended:

1. Reaction and Mechanism by Singh & Mukherjee.
2. Organic Chemistry (Reaction and Mechanism) by P.S. Kalsi.
5. Organic Chemistry by Paula Yurkanis Bruice.
Third Semester  
PAPER B. Sc. - CHEM-306  
PHYSICAL CHEMISTRY

Max.Marks: 50  
Credit - 3

Note for Examiners and Students:

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SECTION-A (12 Hrs)

Chemical kinetics:

Chemical kinetics and its scope. Rates of reaction and factors influencing the rate of reaction (concentration, temperature, pressure, solvent, light and catalyst). Classification of reactions on the basis of molecularity and order. Mathematical derivation of rate equation for first order reaction, second order reaction, third order reaction and pseudo order reaction. Experimental methods for the study of chemical kinetics: conductometric, potentiometric, optical and polarimetric.

SECTION-B (11 Hrs)

Theories of Chemical Kinetics:


Catalysis:

Characteristics of catalysed reactions, classification of catalysts, catalytic poisoning, miscellaneous examples. 
Heterogeneous and homogeneous catalysis, enzyme catalysis, Michaelis–Menten equation.

SECTION-C (11 Hrs)

Thermodynamics:

Definition of thermodynamic terms: System, surrounding, reversible and irreversible processes. Types of systems, intensive and extensive properties, state and path functions and their differentials, thermodynamic processes, concept of heat and work.
Thermochemistry:


SECTION-D(11 Hrs)

First Law of thermodynamics:

Statement, definition of internal energy and enthalpy. Heat capacity and heat capacities at constant volume and constant pressure and their relationship. Joule’s law, Joule-Thomson coefficient and inversion temperature. Calculation of w, q, dU & dH for expansion of ideal gases under isothermal and adiabatic conditions for reversible and irreversible processes.

Books Recommended:

7. Elements of Physical Chemistry by Samual Glastone and David Lewis.
8. Thermodynamics for students of chemistry by Rajaram and J.C.Kuriacose.
Fourth Semester
PAPER B. Sc. CHEM-407
INORGANIC CHEMISTRY

Max.Marks: 50
Credit - 3

Note for Examiners and Students:

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SECTION-A (13 Hrs)

Chemistry of d-Block Elements:

Transition elements, definition, position in periodic table, electronic configuration of atoms and ions. General characteristics such as oxidation state, size, melting and boiling points, reactivity, ionization energies, magnetic behavior, colour, tendency to form complexes, comparison of properties of first transition series with second and third transition series. Brief chemistry and extraction of elements Ti and Co. Preparation, properties and structure of following compounds: TiCl₄, TiO₂, Ziegler Natta Catalyst, CrO₂Cl₂, Prussian blue.

SECTION-B (12 Hrs)

Chemistry of Lanthanide Elements:

Electronic structure, oxidation state, ionic radii and lanthanide contraction, complex formation, occurrence of lanthanides, separation of lanthanides by ion exchange method.

Chemistry of actinides:

General features and chemistry of actinides, chemistry of extraction of Thorium and Uranium from their ores. Similarities between actinides and lanthanides.

SECTION-C (12 Hrs)

Chemistry of Coordination Compounds:

Werner’s coordination theory and its experimental verification. Effective atomic number concept, chelates, nomenclature of coordination compounds, thermodynamic and kinetic stability of coordination compounds, isomerism (structural, stereo and geometrical isomerism in 4 and 6 coordination number compounds.) Optical isomerism in four and six coordination number compounds. Valence bond theory of transition metal complexes. Properties of coordination compounds i.e. magnetic and colors properties.
SECTION-D (08 Hrs)

Acids and Bases:

Arrhenius, Bronsted and Lowry, Lewis, Lux flood and solvent system concepts of acids and bases. Classification of acids and bases as hard and soft. Pearson’s HSAB concept, application of HSAB principle. Relative strength of acids and bases and effect of substituents and solvent on their strength.

Books Recommended:
2. Inorganic Chemistry by T. Moeller.
5. Theoretical Inorganic Chemistry by Day & Selbin.
6. Coordination Chemistry by S.F.A. Kettle
Fourth Semester
PAPER B. Sc. CHEM-408
ORGANIC CHEMISTRY

Max.Marks: 50 Credit - 3

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SECTION-A (12 Hrs.)

Phenols:

Preparation by Dow’s process, from diazonium salt, from cumene & from sulphonic acid. Acidic nature of Phenols and their comparative strength with alcohols and acids. Electrophilic aromatic substitution reactions, acylation reaction and carboxylation reaction of phenols, Fries rearrangement, Claisen rearrangement, Reimer-Tiemann reaction, Kolbes reaction, Schotten-Baumann reaction, Lederer and Manasse reaction and Hauben - Hoesch reaction.

Ethers and Epoxides:


SECTION-B (11 Hrs.)

Aldehydes and ketones:

SECTION-C (11 Hrs.)

**Carboxylic Acids:**


SECTION-D (11 Hrs.)

**Compounds of Nitrogen**

**Amines:**

Structure and nomenclature of amines, physical properties, stereochemistry of amines, methods of separation of mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines, amine salts as phase transfer catalysts. Preparation of alkyl and aryl amines, reduction of nitro compounds, nitriles. Reductive amination of carbonyl compounds. Gabriel phthalimide reaction, Hofmann bromamide reaction. Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acids.

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanism of nucleophilic substitution in nitroarenes and their reduction in acidic, neutral and alkaline medium.

**Halonitroarenes:** reactivity.

**Diazonium Salts:**

Mechanism of diazotisation, structure of benzene diazonium chloride. Replacement of diazo group by H, OH, F, Cl, Br, I, NO₂ and CN groups, reduction of diazonium salts to hydrazines, coupling reaction and its synthetic application.

**Books Recommended:**

1. Reaction and Mechanism by Singh & Mukhergee.
2. Organic Chemistry (Reaction and Mechanism) by P.S. Kalsi.
Fourth Semester
PAPER B. Sc. CHEM-409
PHYSICAL CHEMISTRY

Max.Marks: 50 Credit - 3

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SECTION-A (11Hrs)

Thermodynamics:

The second law of Thermodynamics: Second law of thermodynamics and its necessity. Carnot cycle and its efficiency; Carnot theorem, thermodynamic scale of temperature.


SECTION-B (11 Hours)

Free energy and work function:

Gibb’s function (G) and Helmholtz function(A) as thermodynamic state functions. Variation in A and G with volume, temperature and pressure. A and G as criteria for thermodynamic equilibrium and spontaneity. Maxwell relations. Gibbs - Helmholtz equation and its applications.

Third law of thermodynamics:

The Nernst heat theorem. Evaluation of absolute entropy from heat capacity data and application of third law of thermodynamics.

SECTION-C (11Hrs)

Partial molar properties:

Systems of variable composition, relationship among molarity molality and mole fraction, partial molar quantities, chemical potential (µ) and Gibbs- Duhem equations. Variation of chemical potential with T and P.
Phase equilibria: Chemical potential and phase equilibria. The Clausius - Clapeyron equation

SECTION-D (12 Hours)

Phase Rule:


Solid Solutions:

Compound formation with congruent melting point (Mg-Zn) and incongruent melting (NaCl-H_2O, CuSO_4-H_2O) systems, freezing mixture, acetone-dry ice.

Books Recommended:

3. Thermodynamics, by S. Glasstone.
4. Thermodynamics, by S. Glasstone.
6. Elements of Physical Chemistry by Samuel Glastone and David Lewis.
7. Physical Chemistry by J. Walter Moore.
Fifth Semester
PAPER B. Sc. CHEM-510
INORGANIC CHEMISTRY

Max.Marks: 50 Credit - 3

Note for Examiners and Students:

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SECTION-A (12 Hrs)

Metal- Ligand bonding in transition metal complexes (CFT):

Limitations of valence bond theory, Splitting of d-orbitals in different fields (Octahedral, tetrahedral, tetragonal distorted octahedral, square planner, trigonal bipyramidal), Consequences and applications of orbital splitting, crystal field stabilization energy, magnetic properties, factor affecting extent of splitting, spectrochemical series, colour of transition metal complexes in terms of d-orbital splitting.

SECTION-B (11 Hrs)

Magneto-chemistry:

Origin and type of magnetic behavior shown by transition elements and compounds. Magnetic susceptibility, Gouy’s methods for measuring magnetic susceptibility. Application of magnetic susceptibility measurement to first row metal complexes. Qualitative idea of orbital contribution and abnormal magnetic moments.

SECTION-C (11Hrs)

Thermodynamic and Kinetic Aspect of Metal Complexes:

Definition of stability, step wise formation constants and overall formation constants. Kinetic vs Thermodynamic stability, labile and inert octahedral complexes according to valence bond and crystal field theory. Factors affecting stability of complexes in aqueous solutions, nucleophilic substitution reactions and mechanism in square planer complexes. Trans effect and its theories.
SECTION-D (11Hrs)

Electron Spectra of transition metal complexes:

Types of electronic transition, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series, Orgel-energy level diagrams for $d^{1}$ and $d^{9}$ states, discussion of electronic spectrum of $[\text{Ti(H}_2\text{O})_{6}]^{3+}$.

Books Recommended:
1. Inorganic Chemistry Silver, Atkin and Longford.
4. Mechanisms of Inorganic Chemistry by Basolo and Pearson
5. Theoretical Inorganic Chemistry by Day & Selbin.
6. Coordination Chemistry by S.F.A. Kettle
Fifth Semester
PAPER B. Sc. CHEM-511
ORGANIC CHEMISTRY

Max.Marks: 50 Credit - 3

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SECTION-A (11 Hrs.)

Ultra violet absorption spectroscopy:

Absorption laws [Beer –Lambert law], molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation, concept of chromophore and auxochrome. Bathochromic, hypsochromic hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones, Woodward- Fieser rules, calculation of max. of simple conjugated dienes and \( \alpha, \beta \)-unsaturated ketones. Applications of UV Spectroscopy in structure elucidation of simple organic compounds.

SECTION-B (10 Hrs.)

Infrared absorption spectroscopy:

Molecular vibrations Hook’s law, selection rules intensity and position of IR bands measurement of IR spectrum, fingerprint region, characteristic absorption of various functional groups. Interpretation of IR spectra of simple organic compounds. Applications of IR spectroscopy in structure elucidation of simple organic compounds.

SECTION-C (12 Hrs.)

Nuclear Magnetic Resonance Spectroscopy:

Principle of nuclear magnetic resonance, number of signals, peak areas equivalent & non-equivalent protons, positions of signals, chemical shift. Shielding & deshielding of protons, proton counting, splitting of signals & coupling constants, magnetic equivalence of protons. Discussion of PMR spectra of molecules: ethyl bromide, \( n \)-propyl bromide, isopropyl bromide 1,1-dibromoethane 1,1,2-tribromo
ethane, ethanol, toluene, acetaldehyde, acetophenone. Simple problems on PMR spectroscopy for structure determination of organic compounds.

SECTION-D (12 Hrs.)

Mass Spectroscopy:

Introduction, Basic theory, Mass Spectrum, Base peak, Molecular ion and parent ion, Mass to charge ratio, Relative intensity, Fragmentation of ions, Meta stable ions, Even electron rule, Nitrogen rule, McLafferty rearrangement and ortho effect. General modes of fragmentation of simple molecules, homolytic cleavage, heterolytic cleavage, β-Cleavage, allylic cleavage, benzylic cleavage, Retro Diels - Alder Reaction and simple characteristic features of fragmentation in acetone, anisole, benzaldehyde, ethyl acetate, ethyl amine, ethyl bromide, toluene and isopropyl benzene

Books Recommended:

1. Spectroscopy by Dyer
3. Elementary Organic Spectroscopy by Y.R.Sharma
4. Organic Spectroscopy by Jagmohan, Narosa Publication House
Fifth Semester  
PAPER B. Sc. CHEM-512  
PHYSICAL CHEMISTRY

Max.Marks: 50  
Credit - 3

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SECTION -A (12 Hrs)

Ideal solutions and Raoult’s Law:


Fugacity and activity:


SECTION -B (09 Hrs)

Chemical equilibria:

Equilibrium constant and free energy, thermodynamic derivation of law of mass action and its application. Le Chatellier’s principle, Van’t Hoff reaction isotherms and reaction isochors.

SECTION-C (12 Hrs)

Colligative Properties:

SECTION -D (12Hrs)

Electrochemistry:

Types of reversible electrodes: Nernst equation. Derivation of cell EMF and single electrode potential, standard hydrogen electrode, reference electrode, standard electrode potential, sign conventions.


Books Recommended:

4. Electrochemistry, by S. Glasstone.
5. Thermodynamics, by S. Glasstone.
13. Elements of Physical Chemistry by Samuel Glastone and David Lewis.
Sixth Semester
PAPER B. Sc. CHEM-613
INORGANIC CHEMISTRY

Max.Marks: 50 Credit - 3

Note for Examiners and Students:

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SECTION-A (12 Hrs)

Organometallic Compounds:


SECTION-B (11 Hrs)

Bioinorganic Chemistry:

Essential and trace elements in biological process, metalloporphyrinn with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metals ion with reference to K⁺ & Ca²⁺ and nitrogen fixation.

Inorganic Polymers:

Silicones, preparation and properties of silicones, nomenclature preparation of silicone products, elastomers and their types, ring opening reactions of cyclosiloxanes, polyphophonezones.

SECTION-C (11 Hrs)

Environmental Chemistry:

Environment segments, composition of atmosphere, chemical composition of water bodies (lake, streams, rivers etc.), hydrological cycle, soil composition. Air, water, thermal and soil pollution( source, types and effect of pollutants) Analytical methods of measuring DO, BOD, COD. Analytical examination of sewage and sewage purification. Pollution due to pesticides, its bio-chemical effects and control.
SECTION-D (11 Hrs)

Non Aqueous solvents

Introduction to non aqueous solvents. Effect of the physical properties of the solvent on the role of solvent in chemical reaction. Solvent system concept of acids and base. Elementary study of ammonia and sulphur dioxide as non aqueous solvent.

Perfumes: Introduction to perfumes. Fixatives, synthesis and application of following Perfumes - Musk xylene and Vanaline.

Books Recommended:

1. Inorganic Chemistry by Silver, Atkin & Longford
4. Mechanisms of Inorganic Reactions by Basolo & Pearson
5. Theoretical Inorganic Chemistry By Day & Selbin.
6. Environmental Chemistry by A.K. De
Sixth Semester
PAPER B. Sc. CHEM-614
ORGANIC CHEMISTRY

Max.Marks: 50
Credit - 3

Note for Examiners and Students:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one parts. Section E will be of 18 marks and consists of TEN objective type questions (in MCQ/true and false / fill in the blanks) of one mark each and FOUR short answer questions of two marks each covering the entire paper.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION-A (12 Hrs.)

Carbohydrates:

Classification & nomenclature monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening & chain shortening of aldoses configuration of monosaccharides, erythro & threo diastereomers, conversion of glucose into mannose formation of glycosides, ethers & esters. Determination of ring size of glucose, open chain & cyclic structure of D (+) glucose & D (-) fructose. Mechanism of mutarotation.

An introduction to disaccharides (maltose sucrose & lactose) & polysaccharides (starch and cellulose) without involving structure determination.

SECTION-B (11 Hrs.)

Photochemistry:

General principles about light absorption, electronic transition, introduction scope & importance of photochemistry, comparison between photochemical & thermal reactions, Jablonski diagram (singlet & triplet states, internal conversion, ISC, fluorescence and phosphorescence), photochemical inhibitors, Norrish type I & type II reactions, Paterno- Buchi reaction, photochemical reduction of benzophenone, photochemical reactions of simple alkenes, carbonyl compounds and aromatic compounds, Barton reaction.

Organometallic compounds:

Organomagnesium compounds: the Grignard reagent – formation, structure, and chemical reactions
Organozinc compounds: formation and chemical reactions.
Organolithium compounds: formation and chemical reactions.
SECTION-C (10 Hrs.)

Polynuclear Hydrocarbons:

Synthesis & reactions of Naphthalene, Anthracene & Phenanthrene. Relative reactivity of these compounds at different positions.

Synthetic dyes:

Colour and constitution [electronic concept], classification of dyes. Chemistry and synthesis of methyl orange, congo red, malachite green, crystal violet, phenolphthalein, fluorescein, alizarin and indigo.

SECTION-D (12 Hrs.)

Heterocyclic compounds:

Introduction: Classification and nomenclature, Molecular orbital picture & aromatic characteristics of pyrrole, furan, thiophene & pyridine. Methods of synthesis, chemical reactions with emphasis on mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine. comparison of basicity of pyridine, piperidine and pyrrole.


Books Recommended:

3. Photochemistry by Robert O Cahn
5. Photochemistry by Cox & Kamp
Sixth Semester  
PAPER B. Sc. CHEM-615  
PHYSICAL CHEMISTRY  

Max.Marks: 50  
Credit - 3  

Note for Examiners and Students:  

1. The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one parts. Section E will be of 18 marks and consists of TEN objective type questions (in MCQ/true and false / fill in the blanks) of one mark each and FOUR short answer questions of two marks each covering the entire paper.  

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.  

SECTION -A (11Hrs)  

Elementary Quantum Mechanics:  

SECTION -B (11Hrs)  

Spectroscopy:  


SECTION –C (11 Hours)  

Vibrational spectrum:  
Infra-red spectrum: Energy levels of simple harmonic oscillator; selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies. Effect of isotope on the vibrational spectrum of a diatomic molecule.  

Electronic Spectrum:  
Concept of potential energy curves for bonding and anti-bonding molecular orbitals, qualitative description of selection rules and Franck-Condon principle.
SECTION -D (12Hrs)

Photochemistry:

Difference between thermal and photochemical processes. Laws of photochemistry: Grothus-Draper law, Stark-Einstein Law, Jablonski diagram depicting various processes occurring in the excited state. Qualitative description of fluorescence, phosphorescence, non-radiative processes (Internal conversion, inter system crossing), quantum yield, photosensitized reactions-energy transfer processes (simple processes)

Physical Properties and Molecular Structure:

Optical activity, polarization- (Clausius Mossouetti 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.

Books Recommended:

11. Advance Physical Chemistry by Gurdeep and Harish.
13. Physical Chemistry by S C Khetarpal.
15. Elements of Physical Chemistry by Samuel Glastone and David Lewis.
Additional Elective Course  
Fifth/ Sixth Semester  
PAPER B. Sc. CHEM-616  
INORGANIC CHEMISTRY

Max.Marks: 50  
Credit - 3

Note for Examiners and Students:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one parts. Section E will be of 18 marks and consists of TEN objective type questions (in MCQ/true and false / fill in the blanks)of one mark each and FOUR short answer questions of two marks each covering the entire paper.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION -A (11Hrs)

Fertilizers:

Solid Fuel:
Coal, Different kinds, its formation, origin of coal, analysis of coal (ultimate and proximate analysis).

Explosives:
Introduction, classification, synthesis application of Pentaerythritol tetranitrate and RDX.

SECTION -B (12Hrs)

Cement Industry:

Glass:
Introduction, physical and chemical properties of glass, characteristics of glass, raw materials, chemical reactions, methods of manufacture, Shaping of plate glass, annealing, finishing.
SECTION -C (11Hrs)

Water and Hydrogen peroxide:

Water and its properties, hard and soft water, analysis of hard water (EDTA method), removal of hardness of water (ion exchange method), portable water, heavy water.

Hydrogen peroxide, strength of hydrogen peroxide solution, properties of hydrogen peroxide, structure, uses, tests and estimation of hydrogen peroxide.

SECTION -D (11Hrs)

Chromatography:

Introduction, classification of chromatographic techniques
Paper Chromatography- introduction, principle, migration parameters, types of paper chromatography, experimental details.
Thin Layer Chromatography-Introduction, superiority of TLC over other chromatographic techniques, general applications.
Column Chromatography- principle and applications.

Books Recommended:


Additional Elective Course  
Fifth/ Sixth Semester  
PAPER B. Sc. CHEM-616(Project) 
PROJECT- INORGANIC CHEMISTRY & VIVA

Max.Marks: 25 Credit - 1

The candidate will have to submit a project related to the course content of PAPER B. Sc. CHEM-616 INORGANIC CHEMISTRY(Theory) during the semester. The project will be evaluated by the examiner including viva-voce examination in the area of the project.
Additional Elective Course
Fifth/ Sixth Semester
PAPER B. Sc. CHEM-617
ORGANIC CHEMISTRY

Max.Marks: 50 Credit - 3

Note for Examiners and Students:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one parts. Section E will be of 18 marks and consists of TEN objective type questions (in MCQ/true and false / fill in the blanks)of one mark each and FOUR short answer questions of two marks each covering the entire paper.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION - A (11 Hrs.)

Fats Oils and Detergents:

Natural fats edible and industrial oils of vegetable origin common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value. Soaps and synthetic detergents, alkyl and aryl sulphonates.

Organic Synthesis via enolates:

Acidity of α - hydrogens . Alkylation of diethyl malonate & ethyl acetoacetate. Synthesis of ethyl acetoacetate : the Claisen condensation, keto - enol tautomerism of ethyl acetoacetate, alkylation of 1, 3–dithianes & acylation of enamines

SECTION- B (11 Hrs.)

Polymers:

SECTION- C (11 Hrs.)

Amino acids, Peptides & Proteins:

Classification, acid base behavior, isoelectric point & electrophoresis. Preparation and reactions of amino acids.
Structure and nomenclature of peptides and proteins. Classification of proteins, peptide structure determination, end group analysis, selective hydrolysis of peptides, solid – phase peptide synthesis.
Structure of proteins: primary, secondary & tertiary structure(elementary structure only), denaturation.

SECTION-D (12 Hrs.)

Pharmaceutical Chemistry:

Pharmacokinetics & pharmacodynamics of the drugs, synthesis & therapeutic importance of Sulphanilamide, Aspirin, phenacetin, chloroquin, chloramphenicol. Chemotherapy of sexually transmitted diseases.

Green Chemistry:

Basic concept of wased generation, pollution, atom economy, use of renewable resources, twelve principles of green chemistry. Designing a green synthesis: choice of starting materials, reagents, catalysts and solvents, choice of water as a solvent, microwave & ultrasonic assisted synthesis, biocatalysis. Natural renewable resources such as forest wastes, agro based & polysaccharides as chemical and biodegradable polymers. Examples of green synthesis, recyclization & poly(ethylene terephthalate), synthesis of methyl methacrylate, synthesis of adipic acid & catechol from biomass.

Books Recommended:

3. Polymer Chemistry by Willmaeyer.

Additional Elective Course
Fifth/ Sixth Semester
PAPER B. Sc. CHEM-617(Project)
PROJECT- ORGANIC CHEMISTRY & VIVA
Max.Marks: 25
Credit - 1

The candidate will have to submit a project related to the course content of PAPER B. Sc. CHEM-617 ORGANIC CHEMISTRY(Theory) during the semester. The project will be evaluated by the examiner including viva-voce examination in the area of the project.
Additional Elective Course
Fifth/ Sixth Semester
PAPER B. Sc. CHEM-618
PHYSICAL CHEMISTRY

Max.Marks: 50 Credit - 3

Note for Examiners and Students:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one part. Section E will be of 18 marks and consists of TEN objective type questions (in MCQ/true and false / fill in the blanks) of one mark each and FOUR short answer questions of two marks each covering the entire paper.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION-A(13 Hrs.)

Electrochemistry:


SECTION – B(11 Hrs.)

Interphase Chemistry:


SECTION- C(11 Hrs.)

Basic concepts of polymer chemistry:

Classification of polymers on the basis of composition, degree of polymerization and molecular weight. Homopolymers, co-polymers, graft copolymers, crystalline polymers, amorphous polymers. Classification of polymers on the basis of structure of polymer, i.e., linear, branched, and cross linked.
polymers. Biopolymers, condensation polymers, addition polymers, photopolymerization, mechanism of polymerization, mechanism, of polymerization, polymer degradation, (chemical and photochemical). Dilute polymer solutions, molecular weight of polymers; number average and weight average molecular weights.

SECTION- D (10 Hrs.)

Biophysical Chemistry:

Chemical constituents of living cells. Cell as the smallest biological entity, cell membrane, its structure and function, the plasma membrane, cytoplasm, and organelles. The endoplasmic reticulum, the mitochondria, the Golgi, apparatus, ribosome, lysosomes, centriol and microtubules, the interphase nucleus.

Books Recommended:

1. Physical Chemistry Puri, Sharma and Pathania
2. Quantum Mechanics by G. Aruldhas
3. Adv Physical Chemistry by Gurdeep and Harish
5. Physical Chemistry by S.C. Khetarpal

Additional Elective Course

Fifth/ Sixth Semester

PAPER B. Sc. CHEM-618(Project)

PROJECT- PHYSICAL CHEMISTRY & VIVA

Max.Marks: 25  Credit - 1

The candidate will have to submit a project related to the course content of PAPER B. Sc. CHEM-618 PHYSICAL CHEMISTRY(Theory) during the semester. The project will be evaluated by the examiner including viva-voce examination in the area of the project.
Additional Elective Course  
Fifth/Sixth Semester  
PAPER B. Sc. CHEM-619  
INORGANIC CHEMISTRY

Max.Marks: 50  
Credit - 3

Note for Examiners and Students:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one parts. Section E will be of 18 marks and consists of TEN objective type questions (in MCQ/true and false / fill in the blanks)of one mark each and FOUR short answer questions of two marks each covering the entire paper.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION -A (11Hrs)

Analytical chemistry:

Data analysis- idea of significant figures- its importance- accuracy- methods of expressing accuracy- error analysis- types of errors- minimizing errors- precision- methods of expressing precision-mean, median, mean deviation, standard deviation and confidence limits. 1.2 Chemical and single pan balance- precautions in using balance- sources of error in weighing-correction for buoyancy, temperature effects - calibration of weights.

SECTION -B (12Hrs)

Gravimetric Analysis:


SECTION -C (11Hrs)

Electro Analytical Method :

Polarography- principle, concentration polarization, dropping mercury electrode (DME)- advantages and disadvantages- migration, residual, limiting and diffusion currents- Use of supporting electrolytes-Ikovic equation (derivation not required) and significance- experimental assembly- current voltage curve-oxygen wave-influence of temperature and agitation on diffusion layer. Half wave potential (E1/2)-
Polarography as an analytical tool in quantitative and qualitative analysis. 5.2 Amperometric titrations
Basic principle – titrations- advantages, disadvantages – applications.

SECTION -D (11Hrs)

Symmetry Elements and Symmetry operations:
Groups-point groups of simple molecules like H₂, HCl, CO₂, H₂O & NH₃. some general rules for
multiplication of Symmetry operations. Multiplication tables for H₂O & NH₃. Matrix representation (for
C₂V and C₃V point groups). A brief idea of applications of group theory in chemical bonding
(hybridisation), Raman and IR spectroscopy (Selection rules).

Books Recommended

1. Douglas A, Skoog and Donal M. West Hort, Fundamentals of analytical Chemistry Rinechan and
   ELBS – Longman.
5. F. A. Cotton. Chemical applications of Group Theory, Wiley India Pvt. Ltd.

Additional Elective Course
Fifth/ Sixth Semester
PAPER B. Sc. CHEM-619(Project)
PROJECT- INORGANIC CHEMISTRY & VIVA

Max.Marks: 25 Credit - 1

The candidate will have to submit a project related to the course content of PAPER B. Sc. CHEM-619
INORGANIC CHEMISTRY(Theory) during the semester. The project will be evaluated by the examiner
including viva-voce examination in the area of the project.
Additional Elective Course
Fifth/Sixth Semester
PAPER B. Sc. CHEM-620
ORGANIC CHEMISTRY

Max.Marks: 50 Credit - 3

Note for Examiners and Students:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one parts. Section E will be of 18 marks and consists of TEN objective type questions (in MCQ/true and false / fill in the blanks)of one mark each and FOUR short answer questions of two marks each covering the entire paper.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION –A (12 Hrs)

Pericyclic reactions:


SECTION –B (11 Hrs)

Natural products:

Alkaloids
Natural occurrence, General structural features, Isolation and their physiological action
Hoffmann’s exhaustive methylation, Emde’s modification, Structure elucidation and synthesis of Quinine or Morphine.

Terpenes
Occurrence, classification, isoprene rule; Elucidation of structure and synthesis of α- terpineol.
SECTION –C (10 Hrs)

Petroleum Industry:

Composition and classification of crude petroleum. Refining of petroleum and brief introduction regarding each refining product. Thermal and catalytic cracking of petroleum products. Significance of octane number and cetane number.

Paints and Varnishes:

Classification, constituents and manufacture of paints a varnishes. enamels & lacquers.

SECTION –D (12 hrs)

Molecular Rearrangements:
Classification - anionotropic, cationtropic, intermolecular and intramolecular. Mechanism and applications of following rearrangements:

**Rearrangement to electron-deficient carbon**
(Wagner-Meerwein rearrangement, benzil-benzilic acid rearrangement).

**Electron-deficient nitrogen**
(Beckmann rearrangement, Schmidt rearrangement, Hofmann rearrangement, Lossen rearrangement, Curtius rearrangement).

**Electron-deficient oxygen**
(Dakin reaction).

**Aromatic rearrangements** –
migration from oxygen to ring carbon (Claisen rearrangement); migration from nitrogen to ring carbon (Hofmann-Martius rearrangement, Bamberger rearrangement, Orton rearrangement, benzidine rearrangement).

Books Recommended:

5. Physical Organic Chemistry by Isaccs N.S.,, Pub:Longman

Additional Elective Course
Fifth/ Sixth Semester
PAPER B. Sc. CHEM-620(Project)
PROJECT- ORGANIC CHEMISTRY & VIVA

Max.Marks: 25 Credit - 1

The candidate will have to submit a project related to the course content of PAPER B. Sc. CHEM-620 ORGANIC CHEMISTRY(Theory) during the semester. The project will be evaluated by the examiner including viva-voce examination in the area of the project.
Additional Elective Course
Fifth/Sixth Semester
PAPER B. Sc. CHEM-621
PHYSICAL CHEMISTRY

Max.Marks: 50 Credit - 3

Note for Examiners and Students:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one parts. Section E will be of 18 marks and consists of TEN objective type questions (in MCQ/true and false / fill in the blanks)of one mark each and FOUR short answer questions of two marks each covering the entire paper.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

SECTION-A (12 Hrs)

Electrochemistry:


SECTION-B (12 Hrs)

Thermodynamics and Statistical Mechanics:


SECTION-C (12 Hrs)

Quantum Mechanics:

Eigen functions and Eigen values, quantum mechanical operators and expectation value of a physical quantity. Orthogonality of wave functions. Quantum Mechanics of Simple Systems: free particle, particle in a one and three dimensional box problems and and Harmonic Oscillator.
SECTION-D (12 Hrs)

Reaction Kinetics:


Books Recommended:

1. Physical Chemistry: P.W. Atkins
2. Quantum Chemistry: A.K. Prasad
3. Thermodynamics and Statistical Mechanics: P.V. Panat
4. An Introduction to Statistical Mechanics: P.B. Bal
5. Statistical Thermodynamics: S. Glasstone

Additional Elective Course
Fifth/ Sixth Semester
PAPER B. Sc. CHEM-621(Project)
PROJECT- PHYSICAL CHEMISTRY & VIVA

Max.Marks: 25 Credit - 1

The candidate will have to submit a project related to the course content of PAPER B. Sc. CHEM-621 PHYSICAL CHEMISTRY (Theory) during the semester. The project will be evaluated by the examiner including viva-voce examination in the area of the project.
Open Elective Course  
General Chemistry  
CHEM – 622

Max.Marks: 50  
Credit – 3

Note for Examiners and Students:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be compulsory. Examiner 
will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may 
contain more than one parts. Section E will be of 18 marks and consists of TEN objective type questions (in 
MCQ/true and false / fill in the blanks) of one mark each and FOUR short answer questions of two marks 
each covering the entire paper.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each 
section including the compulsory question. The duration of the examination will be 3 hours.

SECTION-A (12 Hrs.)

Atoms and Molecules:
Mole concept, electronegativity of atoms and polarity of bonds, its variation with position in the periodic 
table, ionization potential, electron affinity, bond lengths, bond angles, hybridization and shapes of some 
simple molecules like CO$_2$, H$_2$O, NH$_3$, CH$_4$.

Atomic Structure:
Bohr’s theory: energy and radius calculations for H-like atoms, quantum numbers, Pauli exclusion 
Principle, qualitative introduction of orbitals, shapes of orbitals, electron distribution of elements - 
Aufbau principle and Hund’s rule.

SECTION-B (12 Hrs.)

Reactions Intermediates and Reagent :
Homolytic and heterolytic cleavage, carbocation, carbanion, free radical, nucleophile, electrophile, 
types of reactions and types of reagents. Simple concept of inductive effect, electromeric effect and 
resonance. Alkanes – free radical substitution reaction, alkenes – electrophilic addition reaction.

Elementary Stereochemistry :
Optical isomerism, concept of chirality, enantiomers and diastereomers, geometrical isomerism, 
examples from organic molecules and inorganic complexes.

SECTION-C (12 Hrs)

Laws in Chemistry:
Law of constant proportion, law of multiple proportion and law of reciprocal proportion, Gas laws-
Boyle’s law, Charle’s law, Avagadro’s law, Graham’s law of diffusion, Dalton’s law of Partial 
Pressure, First, second and third law of thermodynamics, and terms in thermodynamics- state functions, 
state variables, extensive and intensive properties. Types of processes- isothermal, isobaric, 
isochoric,adiabatic, reversible and irreversible . Law of mass action.
Kinetic theory of gases, states of matter, types of solids- amorphous and crystalline solids, simple structure of NaCl, oxidation and reduction- electronic concept, oxidation number, types of chemical bonds.

SECTION D (12 Hrs)

Minerals:
Mineral elements in food-Principal mineral elements-source. Function-Deficiency and daily requirements-Na, K, Mg, Fe, S and P
Vitamins:
Sources, requirement, deficiency diseases of A, C, D, E and K and B₆, B₁₂.

Soil Chemistry:
The composition of soil, sandy clay, shalky, loamy soils, common plant food like nitrate, phosphate and potash and their analysis, pest and its control by neutral and synthetic using pesticides.

Additional Elective Course
Fifth/ Sixth Semester
PAPER B. Sc. CHEM-622 (Project)
PROJECT- GENERAL CHEMISTRY & VIVA
Max. Marks: 25 Credit - 1

The candidate will have to submit a project related to the course content of PAPER B. Sc. CHEM-622 GENERAL CHEMISTRY (Theory) during the semester. The project will be evaluated by the examiner including viva-voce examination in the area of the project.
General Interest Course (Offered by Chemistry Department)  
First/Second/Third Semester  
PAPER B. Sc. - CHEM-23

Total Max.Marks: 50  
Credit – 1  
(L=1, T=0, P=0)

English shall be the medium of instructions and Examinations.  
Examinations shall be conducted at the end of each semester as per the academic calendar notified by H.P. University Shimla-5.

This course will carry 50 marks (Theory Paper Only) and will have following components.

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<th>Component</th>
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<td>Theory Paper</td>
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<td>Continuous Comprehensive Assessment (Internal Assessment)</td>
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<td>Assignment/Class Test/Quiz/Seminar</td>
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<tr>
<td>Minor Tests (2)</td>
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<tr>
<td>Attendance</td>
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<tr>
<td>End- Semester Examination</td>
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Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C and D. Examiner will set eight questions in all, selecting two questions from section A, B, C, and D of 5 marks each.
2. The candidate will be required to attempt five questions in all selecting at least one question from each section. The duration of the examination will be 3 Hours.

SECTION – A (3 Hrs)

Evolution of Chemistry:

Evolution of Chemistry - ancient speculations on the nature of matter, early form of chemistry-alchemy, origin of modern chemistry. Structure of chemical science: scope of chemical science, theory and experiment, branches of chemistry.
SECTION –B (4 Hrs)

Chemistry as a central science:

Role of Chemistry as a central science connecting Physics, Biology and other branches of science. Interdisciplinary areas involving Chemistry - Nanotechnology, Biotechnology. Artificial rain and Global warming.

SECTION-C (4 Hrs)

Chemical Science in the Service of Man:

Chemical science in the service of man: Drugs, food, flavouring agents, sweeteners, cosmetics, soaps and detergents, paints, varnishes, textiles, dyes, fertilizers, insecticides, fuels and propellants.

SECTION-D (4 Hrs)

Some important chemical compounds used in our daily life:

Laboratory and daily life uses of KMnO₄, Na₂CO₃, NaHCO₃, acetic acid (CH₃COOH), sucrose, sodium hypochlorite, hydrogen peroxide, acetone.

Adulterants and Food Additives:

Adulterants in milk, ghee, oil, coffee powder, tea, chilli powder, pulses and turmeric powder – identification.

Book:

J. A Lee, Scientific Endeavor, Addison Wesley Logman, C. N. R. Rao, University General Chemistry Mc Millan (Indian Ltd.), Physical Chemistry by Paul Monk
PRACTICAL COURSES

First Semester
PAPER- B. Sc. CHEM-101(P)
Inorganic Chemistry(lab)

Max. Marks: 25 Credit - 1

Each Practical examination shall be of three hours duration.

The contents of practicals shall consist of the following:

1. Preparation of standard solutions:
   i) Preparation of N/10 NaOH solution and its standardization with HCl.
   ii) Preparation of N/20 K₂Cr₂O₇ solution and its standardization with Mohr’s salt.
   iii) Preparation of N/2 KMnO₄ solution and its standardization with FeSO₄.

2. Volumetric analysis:
   i). Iodometry and Iodimetry titrations:
      i) Standardization of sodium thiosulphate with potassium dichromate
      ii) Determination of Cu (II) (Double Titrations)
      iii) Determination of available chlorine in bleaching powder.
      iv) Standardization of I₂ with Na₂S₂O₃.
      v) Determination of Sb (III) in tartaremetic

   ii). K₂Cr₂O₇ titrations:
      i) Standardization with Fe (II).
      ii) Determination of Ferric ions (Double Titrations)
      iii) Determination of Chemical Oxygen Demand (COD) in the waste water.

Books Recommended:

1. Vogel’s Text Book of Quantative Inorganic analysis (revised) J. Bassett, R.C Cdenney, G H Jettery and J Mendhan, ELBS.
3. Experimental inorganic Chemistry by W G Paimer.
First Semester
PAPER- B. Sc. CHEM-102(P)
Organic Chemistry (lab)

Max. Marks: 25       Credit - 1

Practical examination shall be of three hours duration.

The contents of practicals shall consist of the following:

1. **Qualitative organic analysis:**
   
   Detection of elements (N, S and halogens) and functional groups – Phenol(α- & β- naphthols),
   carboxylic acid( benzoic and cinnamic acid), , carbohydrates(Glucose & fructose), , amides(urea and benzaamide), m- dinitrobenzene and naphthalene. Determination of melting point.

2. **Purification of organic compounds by crystallization:**
   
   Oxalic acid, Urea, Glucose, Acetamide.

**Recommended Books:**

1. *Vogel’s Text Book of Qualitative Organic analysis (revised)* J. Bassett, R.C Cdenney, G H Jettery and J Mendhan, ELBS.
Max. Marks: 25

Practical examination shall be of three hours duration.

The contents of practicals shall consist of the following:

1. (i) Determination of surface tension of pure liquids.
   (ii) Determination of viscosity of pure liquids.
   (iii) Determination of % age composition of the given mixtures from surface tension and
         viscosity measurements.
2. **Preparation of colloidal solutions**: As$_2$S$_3$, Fe(OH)$_3$

**Recommended Books:**

3. Experimental Physical Chemistry by J C Ghose.
4. Experimental Physical Chemistry: B.D Khosla

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Max. Marks: 25

Practical examination shall be of three hours duration.

The contents of practicals shall consist of the following:

1. **Paper chromatography**: Qualitative analysis of anyone of the following inorganic cations or
   anions by paper chromatography (Cu$^{2+}$, Ni$^{2+}$, NO$_3^-$, Cl$^-$)

2. Qualitative inorganic analysis of mixture containing four radicals (two acidic and two basic) &
   may contain one interfering radical.

**Recommended Books:**

1. Vogel’s Text Book of Qualitative Inorganic analysis (revised) J. Bassett, R.C. Cdenney, G. H.
   Jetter and J. Mendhan, ELBS.
Max. Marks: 25

Practical examination shall be of three hours duration.
The contents of practicals shall consist of the following:

1. Organic Synthesis:
   i) Preparation of Iodoform.
   ii) Preparation of p-bromoacetanalide from acetanilide.
   iii) Preparation of glucosazone.
   iv) Preparation of aspirin.

2. Thin Layer and Column Chromatography:
   i) Determination of Rf value and purity of organic compounds by use of thin layer chromatography.
   ii) To analyze the analgesic drug APC by thin layer chromatography.
   iii) Separation of mixture of o-nitro aniline and p-nitro aniline by Column Chromatography.

Recommended books:

1. Vogel’s Text Book of Quantitative organic analysis (revised) J. Bassett, R.C Cdenney, G H Jettery and J Mendhan, ELBS.

Max. Marks: 25

Practical examination shall be of three hours duration.
The contents of practicals shall consist of the following:

1. Thermochemistry:
   i) Determination of Water Equivalent of a thermoflask.
   ii) Determination of heat of solution of KNO₃ and KCl.
   iii) Determine the enthalpy of neutralization between strong acid and strong base.
   iv) Determine the enthalpy of hydration of CuSO₄.

2. Chemical Kinetics:
   i) Determine the order of reaction of hydrolysis of ethyl acetate in acidic medium.
   ii) Determination of kinetics of reaction between sodium thiosulphate and hydrochloric acid by initial rate method.

Recommended Books:

3. Experimental Physical Chemistry by J C Ghose.
Fourth Semester
PAPER- B. Sc. CHEM-407(P)
Inorganic Chemistry (lab)

Max. Marks: 25
Credit - 1

Practical examination shall be of three hours duration.

The contents of practicals shall consist of the following:

1. Qualitative inorganic analysis
   Qualitative inorganic analysis of mixture containing six radicals including interfering radicals (PO$_4^{3-}$, C$_2$O$_4^{2-}$, BO$_3^{3-}$).
   2. EDTA titrations: Estimation calcium, magnesium and zinc, determination of permanent hardness of water by EDTA titrations.

Books Recommended:
1. Vogel’s Text Book of Qualitative Inorganic analysis (revised) J. Bassett, R.C Cdenney, G H Jettery and J Mendhan, ELBS.
3. Experimental inorganic Chemistry by W G Paimer.

Fourth Semester
PAPER- B. Sc. CHEM-408(P)
Organic Chemistry (lab)

Max. Marks: 25
Credit - 1

Practical examination shall be of three hours duration.

The contents of practicals shall consist of the following:

1. Qualitative Organic analysis:
   Qualitative analysis of the following organic compounds for
   i) Detection of extra elements (N, S and Halogens)
   ii) Determination of functional groups
   iii) Determination of melting point
   iv) Specific tests
   v) Preparation of solid derivative( Benzoic acid, cinnamic acid, oxalic acid, α- & β-naphthol, glucose, fructose, sucrose, urea, thiourea, acetamide, benzamide, m-dinitrobenzene, β- naphthyl amine and naphthalene).
   2. Determination of boiling points: Ethanol 78$^0$, Cyclohexane 81.4$^0$, Toluene 110.6$^0$, Benzene 80$^0$.

Books Recommended:
1. Vogel’s Text Book of Qualitative organic analysis (revised) J. Bassett, R.C Cdenney, G H Jettery and J Mendhan, ELBS.
Fourth Semester
PAPER- B. Sc. CHEM-409(P)
Physical Chemistry (lab)

Max. Marks: 25  Credit: 1

Practical examination shall be of three hours duration.

The contents of practicals shall consist of the following:

Physical Chemistry:
1. **Photocolorimetry**: Estimation of $\text{Co}^{2+}$, $\text{Ni}^{2+}$, $\text{Cu}^{2+}$
2. i) Determination of molecular weight of naphthalene by Rast method
   ii) Determination of CST of Phenol – Water system

Recommended Books:
3. Experimental Physical Chemistry by J C Ghose.

Fifth Semester
PAPER- B. Sc. CHEM-510(P)
Inorganic Chemistry (lab)

Max. Marks: 25  Credit: 1

Practical examination shall be of three hours duration.

The contents of practicals shall consist of the following:

1. **Inorganic preparations:**
   1) Preparation of cuprous chloride.
   2) Preparation of Tetrammine copper (II) Sulfate.
   3) Preparation of Potassium trioxalatoaluminate(III)
2. Ceric sulfate titration: Estimation of nitrite and oxalate.
3. Estimation of calcium content of chalk as calcium oxalate by permanganometry

Books Recommended:
2. Vogel’s Text Book of Quantitative Inorganic analysis (revised) J. Bassett, R.C Cdenney, G H Jettery and J Mendhan, ELBS.
Fifth Semester
PAPER- B. Sc. CHEM-511(P)
Organic Chemistry (lab)

Max. Marks: 25
Credit - 1

Practical examination shall be of three hours duration.

1. i) Estimation of acid value, iodine value and saponification value of a given oil and fat.
   ii) Preparation of Nylon-66
2. Distillation:
   i) Simple distillation of ethanol-water mixture using water condenser.
   ii) Distillation of nitrobenzene and aniline using air condenser.

Recommended Books:

1. Vogel’s Text Book of Quantitative organic analysis (revised) J. Bassett, R.C Cdenney, G H Jettrey and J Mendhan, ELBS.

Fifth Semester
PAPER- B. Sc. CHEM-512(P)
Physical Chemistry (lab)

Max. Marks: 25
Credit - 1

Practical examination shall be of three hours duration.

The contents of practicals shall consist of the following:

Experiments Physical Chemistry

1. Conductometric Titrations:
   Titration of
   i) Mixture of strong acid and weak acid with NaOH
   ii) KCl with AgNO₃

2. i) Study of adsorption of acetic acid on activated charcoal – Langmuir adsorption isotherm.
   iii) Separation of a mixture of Benzoic acid and 2- Naphthol by solvent extraction and identification of their functional groups.

Books recommended:

3. Experimental Physical Chemistry by J C Ghose.
Sixth Semester
PAPER- B. Sc. CHEM-613(P)
Inorganic Chemistry (lab)

Max. Marks: 25  Credit - 1

Practical examination shall be of three hours duration.
The contents of practicals shall consist of the following:

1. **Gravimetric analysis:**
   i) Estimate Barium/\(\text{SO}_4^{2-}\) as Barium sulfate by gravimetric method
   ii) Quantitative estimation of \(\text{Cu}^{2+}\) as copper thiocyanate and \(\text{Ni}^{2+}\) as Nickel DMG.
   iii) Estimation of iron as ferric oxide from a solution of Mohr’ salt.
   iv) Estimation of aluminium as aluminium oxide
   v) Estimate chromium (III) as lead chromate.

2. **Inorganic Preparations:**
   i) Preparation of Prussian blue.
   ii) Preparation of potassium trioxalato ferrate (III).
   iii) Preparation of Hexamine Nickel (II) chloride.

**Books recommended:**

2. Vogel’s Text Book of Quantitative Inorganic analysis (revised) J. Bassett, R.C Cdenney, G H Jettery and J Mendhan, ELBS.

Sixth Semester
PAPER- B. Sc. CHEM-614(P)
Organic Chemistry (lab)

Max. Marks: 25  Credit - 1

Practical examination shall be of three hours duration.
The contents of practicals shall consist of the following:

1. **Extraction:**
   i) Lycopene from tomato
   ii) Casein from milk
   iii) Preparation of benzpinacolone from benzpinacol (pinacol-pinacolone rearrangement).

2. **Preparation and Estimation:**
   i) Preparation of methyl orange and its use as azo dye
   ii) Preparation of \(m\)-dinitrobenzene from nitrobenzene.
   iii) To estimate the strength of given glucose solution (Fehling method).

**Books Recommended:**

1. Vogel’s Text Book of Quantitative organic analysis (revised) J. Bassett, R.C Cdenney, G H Jettery and J Mendhan, ELBS.
Sixth Semester
PAPER- B. Sc. CHEM-615(P)
Physical Chemistry (lab)

Max. Marks: 25
Credit - 1

Practical examination shall be of three hours duration.

The contents of practicals shall consist of the following:

1. **Partition coefficient**: i) Determination of distribution coefficient of Iodine between water and carbon tetrachloride.
   
   ii) Determination of distribution coefficient of benzoic acid between benzoic acid and water

2. i) To determine the strength of the given acid solution (monobasic and dibasic) conductometrically.
   
   ii) To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.

Books Recommended:


3. Experimental Physical Chemistry by J C Ghose.
### SCHEME OF CREDIT FOR B.SC. (CHEMISTRY) COURSE IN DIFFERENT SEMESTERS FOR H P UNIVERSITY UNDERGRADUATE CLASSES FROM ACADEMIC SESSION -2013-14. (B. Sc) I, II, III Year Chemistry

<table>
<thead>
<tr>
<th>Semester</th>
<th>Subject Code</th>
<th>Subject Title</th>
<th>Credit</th>
<th>Hours Per Week</th>
<th>Evaluation Scheme</th>
<th>EE Total MarkS</th>
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<td>Th    Pr  As/CT/Sp</td>
<td>MT&lt;sub&gt;1&lt;/sub&gt; MT&lt;sub&gt;2&lt;/sub&gt; At  Pr</td>
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**Th = Theory, Pr = Practical, As = Assignment, CT = Class Test, S = Seminar, MT<sub>1</sub>= minor test, At = Attendance, EE = End Term Exams.**