B.Sc. Ist Semester-Chemistry

Course No:* DSC-2A** ***Max. Marks: 80
Course Weightage: 04 Credit ***End Term Exam: 60***
No. of Contact Hours: 60 ***Continuous Assessment: 10***
Attendance: 10

Unit-I Chemical Bonding and Molecular Structure: (18 Contact hours)

Chemical Bonding-I

Ionic Bond: Lattice energy and Born Haber Cycle. Factors affecting the structure of ionic solids; Radius ratio effect; Coordination number and limitations of radius ratio rule. Fajan's rules and its applications.

Solvation energy and solubility of ionic solids. Factors affecting the solubility of ionic solids.
Metallic bond: Characteristics, comparison with ionic and covalent bonds .Theories (Free electron, VB and MO).

Chemical Bonding-II

***Valence bond theory*:** Directional characteristics of covalent bond and types of hybridizations. Limitations of VB theory. Percent ionic character from dipole moment and electronegativity difference.

***VSEPR theory*:** Assumptions; Shapes of some molecules (BF_3, NH_3, H_2O, SF_4, ClF_3 and XeF_2)
Molecular Orbital Theory: Energy level diagrams, Bond order and its significance. Magnetic properties of homo & hetero nuclear diatomic molecules (N_2, O_2, F_2, HCl, CO & NO).
Multicenter bonding in electron deficient molecules.

Unit-II s Block Elements: (12 Contact hours)

Chemical Reactivity towards Water, Oxygen, Hydrogen, Nitrogen and Halogens. Anomalous behaviour and diagonal relationships (Lithium, Beryllium, Magnesium and Aluminum). Chemical characteristics of the compounds of alkali and alkaline earth metals (Oxides and Hydroxides).

Hydrides: Classification and general properties.

Some commercially important compounds:- Sodium carbonate, Calcium carbonate and Calcium sulphate (Preparation, properties and Uses).
Effective nuclear charge and its calculation by Slater rules. Electronegativity and Electron Affinity: Trends , Methods of determination ; Applications in predicting and explaining the chemical behavior of elements.

Unit-III Aromaticity and Methods of determination of Reaction Mechanism: (14 Contact hours)

Aromaticity: Requirements of aromaticity. Huckel's rule and its significance. Explanation using molecular orbital diagram of benzene. Aromaticity of non-benzenoid compounds like pyrrole, thiophene, furan and aromatic ions (3, 5 and 7-membered rings).

Reactive intermediates: Structure, generation and stability of Carbocations, Carbanions, Free radicals, Carbenes, Benzynes and Nitrenes.

Methods of determination of Reaction Mechanism: Identification of Products, Isotope labeling, Sterochemical and Kinetic evidences.

Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis – trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (upto two C=C systems).

Unit-IV Structure, Synthesis and Reactions of Alkenes, Dienes, Alkynes and Alkyl halides: (16 Contact hours)

Alkenes: Preparation of alkenes from alcohols and alkyl halides through elimination reaction.Hoffman and Saytzev's rules. Mechanism and Stereochemical implications. Mechanistic details including regioselectivity and stereochemical implications of halogenation, hydrohalogenation, hydroboration, epoxidation, hydroxylation and ozonolysis. Substitution at allylic and vinylic positions of alkenes.

Dienes: Structure of isolated, conjugated and cumulative dienes. 1,2 and 1,4-additions of 1,3-butadiene. Mechanism and Stereochemistry of Diels's-Alder reaction. Mechanism of Birch reduction.

Alkynes: Structure and acidic character of alkynes. Mechanisms of addition of halogens, hydrogen, halides, hydration, hydroboration and catalytic and metal-ammonia reductions of alkynes.

***Alkyl halides*:** Classification,methods of preparation and reactions of alkyl halides. Mechanistic details of S_N1 and S_N2 E1 and E2 reactions. Effects of structure of alkyl halides, nature of nucleophiles, leaving groups, solvent and stereochemical implications of S_N reactions. Substitution versus Elimination.

Books Recommended

1. Basic Inorganic Chemistry; F.A. Cotton, G Wilkinson & P.L. Gauss; 3rd ed.; Wiley; 2002.
2. Inorganic Chemistry ; A.G. Sharpe; 3rd ed.; ELBS, 1992.
3. Concise Inorganic Chemistry; J.D . Lee; 5th ed.; ELBS; 2003.
4. Inorganic Chemistry . G.L. Miessler, T. A Tarr; 3rd ed.; Prentice Hall; 2009
5. Inorganic Chemistry ; D.E. Shriver ; P.W. Atkins & C.H. Langford ; 4th ed.; Oxford; 2006
6. Concepts and models of Inorganic Chemistry ; B. Douglas ; D.Mc. Daniel & J. Alexander; 3rd ed.; Wiley; 2001.
7. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
8. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
9. Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
10. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
11. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
12. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.

B.Sc. Ist Semester-Chemistry

Course No:* DSC-2A Lab.** ***Max. Marks: 20
Course Weightage: 02 Credit ***End Term Exam: 15***
No. of Contact hours: 30 ***Attendance:05***

Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)
2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)

(a) Identify and separate the components of a given mixture of two amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
(b) Identify and separate the sugars present in the given mixture by paper chromatography.

Books Recommended:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

B.Sc. IInd Semester-Chemistry

Course No: **DSC-2B** ***Max. Marks: 80***
Course Weightage: 04 Credit ***End Term Exam: 60***
No. of Contact hours: 60 ***Continuous Assessment: 10***
Attendance : 10

Unit-I Thermodynamics and Equilibrium: (16 Contact hours)

Thermodynamic functions: State and path functions and their differentials. Thermodynamic processes. Concept of heat and work.Heat capacity, heat capacities at constant volume and constant pressure and their relationship.Joule's law, Joule-Thomson coefficient and inversion temperature.Calculation of ΔU &ΔH for the expansion of ideal and non-ideal (van der Waals) gases under isothermal and adiabatic conditions.Temperature dependence of enthalpy, Kirchhoff's equation.

Bond dissociation energy and its calculation from thermo-chemical data with applications.
Second law of thermodynamics: Need for the law, different statements of the law. Carnot cycle and its efficiency, Carnot theorem.Thermodynamic scale of temperature.

Concept of entropy, entropy as a function of V&T, and as a function of P&T. Clausius inequality; entropy as criteria for spontaneity and equilibrium. Entropy change in physical processes, ideal gas expansion and entropy of mixing of ideal gases.

Third law of thermodynamics: Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, Nernst heat theorem, third law of thermodynamics, concept of residual entropy, evaluation of absolute entropy from heat capacity data. ΔG &ΔA as criteria for thermodynamic equilibrium and spontaneity.their advantage over entropy change. Variation of G and A with P, V and T, Gibbs-Helmholtz equation.

Unit-II Electrochemistry: (14 Contact hours)

Migration of ions and Kohlrausch's law, Arrhenius theory of electrolyte dissociation and its limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment without derivation). Transport number, definition and determination by Hittorf's and moving boundary methods. Application of conductivity measurements: determination of degree of dissociation and dissociation constants of acids, solubility product of a sparingly soluble salt, conductometric titrations.

Types of reversible electrodes (half-cells): metal-metal ion, gas-metal-ion, metal-insoluble salt-anion and redox electrodes. Standard hydrogen electrode, glass electrode, reference electrodes (calomel, Ag/AgCl). Electrode reactions, Nernst equation and cell E.M.F. Electrochemical series and its significance.

Electrolytic and Galvanic cells.Measurement of EMF of a cell.Concentration cells, electrolyte concentration cell (with and without transport), electrode concentration cell.

Application of standard potentials: determination of thermodynamic functions of cell reactions (ΔG, ΔH and K.), pH and pKa, solubility product and activity coefficient; potentiometric titrations.

Unit-III Aromatic Compounds and Oxygen Bearing Compounds-I:

(16 Contact hours)

***Aromatic Electrophilic Substitution Reactions*:** General mechanism of aromatic electrophilic substitution reactions.Formation of Sigma and pi-complexes with energy profile diagram. The

second substitution-concept and role of activating and deactivating groups. *Ortho* and *para* ratio. Mechanisms of Fries and Claisen rearrangements and Gatterman, Huben-Hoesch, Veils-Meir-Haack and Riemer-Tieman reactions.

Aromatic Nucleophilic Substitution Reactions:

Aryl halides: Methods of preparation of aryl halides with mechanistic details of the reactions involved. Addition-Elimination and Elimination-Addition mechanisms of nucleophilic aromatic substitution reactions involving aryl halides. Mechanism of nucleophilic aromatic substitution reaction in nitroarenes.

Oxygen bearing compounds-I:

Alcohols: Classification. Methods of formation of monohydric alcohols through reduction of aldehydes, ketones, carboxylic acids and esters using different reducing agents including mechanistic details of the reactions involved. Reactions of alcohols including Pinacole-Pinacolone rearrangement with mechanism. Methods of formation and the oxidative cleavage reactions of diols.

Epoxides: Methods of formation and mechanism of acid/base catalysed ring openings of epoxides. Reactions of Grignard and organolithium reagents with epoxides.

Ethers: Mechanisms involved in the synthetic procedures of ethers, their cleavage and auto-oxidation.

Unit-IV Oxygen Bearing Compounds-II: (14 Contact hours)

Aldehydes and Ketones: Structure and reactivity of carbonyl groups. Synthesis of aldehydes starting from acid chlorides and those of ketones from nitriles, carboxylic acids and 1,3-dithianes. Stereochemistry and mechanism of nucleophilic additions to carbonyl groups. Cram's rule.

Mechanisms involved in Benzoin, Aldol/Cross Aldol, Perkin,Knoevenegal,Cannizzaro and Mannich condensations/reactions. Meerwein-Pondroff-Verly, Clemmenson and Wolf-Kishner reductions and Baeyer-Villegar & Oppenaur Oxidations. Mechanisms of acid and base catalysed halogenation in aldehydes and ketones.

***Carboxylic acids and their derivatives*:** Structure of carboxylic group. Factors affecting strength of carboxylic acids. Mechanistic details of preparation of carboxylic acids using Grignard reagent and from hydrolysis of nitriles. Mechanisms involved in the HVZ reaction, conversion of acids to corresponding chlorides, esters, anhydrides and amides. Relative stabilities and interconversion of acid derivatives into one another. Reduction of carboxylic acids and their derivatives. Transesterification and hydrolysis of esters.

Applications of Ethylacetoacetate and Malonic ester in organic synthesis.

Books Recommended

1. Principles of Physical Chemistry; Puri, Sharma and pathania; S. Nagin Chand & Co; 2011
2. The Elements of Physical Chemistry; P.W. Atkins; Oxford University Press;
3. Physical Chemistry; G.M. Barrow; McGraw-Hill; 5th ed.; International Student edition; 1992
4. Physical Chemistry; R.A. Alberty; Wiley; Eastern Ltd.
5. Physical Chemistry; Castellan, G.W. 4th ed. Narosa; 2004.

6. A textbook of Organic Chemistry; R.K. Bansal; 4th ed.; Wiley-Eastern; 2003.
7. Organic Chemistry; Vol I & II; I. L. Finar; 6th ed.; ELBS; 2004.
8. Organic Chemistry; Morrison and Boyd; 6th ed.; PHI; 2003.
9. Organic Chemistry Reaction Mechanism; R. K. Bansal; 3rd ed., 2003.
10. Advanced Organic Reaction Mechanism; Peter Sykes; 6th ed.; Orient Longmann; 2007.
11. Reaction Mechanism in Organic Chemistry; Mukherji and Singh; 3rd ed.; Macmillan; 2007.
12. Advanced Organic Chemistry; Jerry March, 6th ed.; Wiley; 2001.

B.Sc. IInd Semester-Chemistry

Course No:* DSC-2B Lab.** ***Max. Marks: 20
Course Weightage: 02 Credit ***End Term Exam: 15***
No. of Contact Hours: 30 ***Attendance:05***

Section A: Physical Chemistry

Thermochemistry:

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH.

Ionic equilibria

pH Measurements:

1. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.
2. Preparation of buffer solutions of the following compositions:
   (a) Sodium acetate-acetic acid
   (b) Ammonium chloride-ammonium hydroxide

Measurement of the pH of above buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed.

Recrystallisation, determination of melting point and calculation of quantitative yields to be done.

(a) Bromination of Phenol/Aniline
(b) Benzoylation of amines/phenols
(c) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone

Books Recommended:

1. Selected Experiments in Physical Chemistry, N.G. Mukherjee, J.N. Ghosh & Sons.
2. Experiments in Physical Chemistry, R. C Das and B. Behra (Tata McGraw Hill)
3. Advanced Practical Physical Chemistry, J.B. yadav; Goel Publishing House; 20th ed.; 2001.
4. Advanced Experimental Chemistry; J.N. Gurtu and R. Kapoor; Vol. I; 1st ed.; S. Chand & Co; 2000.
5. Practical Physical Chemistry; Khosla, B. D.; Garg, V. C. & Gulati, A.; R. Chand & Co.; 2011.
6. Textbook of Practical Organic Chemistry; Vogel, A.I.; Tatchell, A.R; Furnis, B.S., Hannaford, A.J. & Smith, P.W.G;, 5th ed.; Prentice-Hall; 1996.
7. Practical Organic Chemistry; Mann, F.G. & Saunders, B.C.; Orient-Longman; 1960.
8. Laboratory Manual in Organic Chemistry; R.K. Bansal; Wiley Eastern.
9. Experimental Organic Chemistry;; P.R. Singh, D.S. Gupta and K.S. Barpal; Vol I & II Tata McGraw Hill.
10. Advanced Practical Organic Chemistry; N. K. Vishnoi; Vikas Publishing House Pvt Ltd; 1996.

B.Sc. III Semester-Chemistry

Course No:* DSC-2C** ***Max. Marks: 80
Course Weightage: 04 Credit ***End Term Exam: 60***
No. of Contact Hours: 60 ***Continuous Assessment: 10***
Attendance: 10

Unit-I p-Block Elements: (16 Contact hours)

***Boranes*:** Nomenclature, Classification, Preparation, Properties, Structure and Bonding with special reference to Diborane.
Bonding in higher boranes: Types of bonds, Introductory concept about carboranes and metallocarboranes.

***Carbides*:** Classification, Preparation, Properties and Uses. Intercalation compounds of graphite.
Nitrogen Compounds: Preparation, properties and uses of Hydrazine, Hydroxylamine and Oxides and Oxoacids of nitrogen. Ammonia as a non-aqueous solvent.
***Oxygen*:** Chemistry of different forms (atomic , molecular and ozone). Oxides, Fluorides and Oxyacids of Sulphur: Properties, Structure & Bonding. Hydrogen Peroxide: Preparation, Properties and Uses.

Halogens: Comparative chemical reactivity, Types, Properties, Structure & Bonding of hydrogen halides, Interhalogens and Polyhalides.

Oxyacids of Chlorine: Structure and Bonding.

Noble gases: Isolation and importance of noble gases in theoretical chemistry.

Fluorides, oxides and oxyfluorides of Xenon: Structure and bonding (VB and MO treatment)

Unit-II Transition and Inner-Transition Elements: (14 Contact hours)

***Transition Elements*:** Variation in atomic and ionic sizes, Ionization enthalpies, Variable oxidation states. Standard electrode Potentials of M^{2+} / M and M^{3+} / M^{2+} systems.

Ionic / Covalent and Acidic / Basic character of transition metal oxides in various oxidation states. Stabilization of unusual oxidation states.

Spectral and Magnetic Properties; Calculation and Uses of magnetic moment value.

Interstitial Hydrides, Carbides and Oxides of first transition series:- Preparation, Properties & Uses.

Inner-Transition Elements: Electronic Configuration, Oxidation States, Magnetic Properties and Complexing behavour of inner transition elements.

Cause and Consequences of Lanthanoid / Actinoid Contraction.

Separation of Lathanoids: Fractional Crystallization, Ion–exchange and Solvent extraction methods.

Unit- III Equilibrium and Solution thermodynamics: (14 Contact hours)

Equilibrium: Equilibrium constant and free energy change. Thermodynamic derivation of law of mass action.Reaction isotherm and reaction isochore, Clapeyron equation and Clausius-Clapeyron equation, applications.
Phase Equilibria: Phase rule, Meaning of the terms: phase, component and degree of freedom, statement and derivation of Gibbs phase rule, phase diagrams of one component system – water andsulphur systems.

Phase equilibria of two component system: solid-liquid equilibria, simple eutectic system (Pb-Ag), desilverisation of lead.

Solid solutions - compound formation with congruent melting point (Mg-Zn) and incongruent

melting point ($FeCl_3$-H_2O systems). Freezing mixtures, acetone- dry ice.

Liquid-liquid mixtures: Ideal liquid mixtures, Raoult's and Henry's law. Non-ideal systems, azeotropes (HCl-H_2O and C_2H_5OH-H_2O systems.)

Partially miscible liquids: Lower and upper consolute temperatures, (examples of phenol-water, trimethylamine-water, nicotine-water systems).

Nernst distribution law: Statement and thermodynamic derivation, applications.

***Thermodynamics of Solutions*:** Thermodynamics of elevation in .boiling point and depression in freezing point. Activity and activity coefficient, determination of activity and activity coefficient with freezing point and EMF methods. Excess thermodynamic functions of non-ideal solutions.

Unit-IV Chemical kinetics &Photochemistry: (16 Contact hours)

Order of reaction; derivation of rate equations for second (two reactants) and third order reactions. Determination of order of reaction by differential rate, integration, half life period and isolation methods.

Temperature dependence of reaction rates:-Arrhenius equation, concept of activation energy.

Theories of chemical kinetics*:* Simple collision theory based on hard sphere model, evaluation of rate constants of atomic reactions, extension to molecular reactions, limitations. Brief idea of transition state theory (equilibrium hypothesis).

Catalysis: Characteristics of catalyzed reactions, Acid-Base catalysis with examples

Photochemistry: Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry.Grothus-Drapper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing) quantum yield, photosensitized reactions, energy transfer processes (simple examples).

Kinetics of photochemical reactions: Photochemical decomposition of hydrogen iodide. Hydrogen-chlorine and hydrogen-bromine reactions, Comparison with thermal decomposition reactions.

Books Recommended:

1. Basic Inorganic Chemistry; F.A. Cotton; G. Wilkinson & P.L. Gauss; 3rd ed.; Wiley; 2002.
2. Chemistry of Elements; Greenwood Earnshaw; 2nd ed.; Butterworth; 2000.
3. Advanced Inorganic Chemistry; Prakash, S.; Tuli, G.D.; Basu, S.K. & Madan, R.D.; Vol. 1.; S. Chand & Co.
4. Inorganic Chemistry; Miessler G.L.& Tarr, T.A.; 3rd ed.; Prentice Hall; 2009
5. Inorganic Chemistry; Shriver, D.E.; Atkins, P.W. & Langford, C.H.; 4th ed.; Oxford; 2006.
6. Concepts and Models of Inorganic Chemistry; Douglas, B.; Daniel, D. Mc. & Alexander, J.; 3rd ed.; Wiley; 2001.
7. Advanced Inorganic Chemistry; Prakash, S.; Tuli, G.D.; Basu, S.K. & Madan, R.D.; Vol. 1.; S. Chand & Co.
8. Principals of Physical Chemistry; Puri, Sharma and Pathania; S. Nagin Chand & Co; 2011.
9. The Elements of Physical Chemistry; Atkins, P. W.; Oxford University Press.
10. Physical Chemistry; Barrow, G. M.; 5thed.; McGraw-Hill; International Student edition; 1992.
11. Physical Chemistry; Alberty, R. A.; Wiley Eastern Ltd.
12. Essentials of Physical Chemistry;; Kapoor, K. L.; Vols. III & IV; 2nded.; Macmillan India Ltd; 2005.
13. Physical Chemistry through Problems; Dogra, S. K.; Wiley Eastern Ltd; 1991.
14. University General Chemistry; Rao, C. N. R.; MacMillan.

B.Sc. IIIrd Semester-Chemistry

Course No: **DSC-2C Lab.** ***Max. Marks: 20***
Course Weightage: 02 Credit ***End Term Exam: 15***
No. of Contact hours: 30 ***Attendance:05***

Section A: Inorganic Chemistry

(a) Qualitative Analysis: To identify the given Inorganic mixture containing three acidic and three basic radicals (excluding insoluble and interfering radicals) by Macro Scale Analysis (06 known and 06 unknown mixtures)

(b) Paper Chromatography: Separation and identification of metals from mixtures containing two cations (03 exercises)

Section B: Physical Chemistry

Phase equilibria

a) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.

b) Determination of the critical solution temperature and composition of the phenol water system and study the effect of impurities on it.

c) Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

Chemical Kinetics

Study the kinetics of the following reactions.

1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:

a. Acid hydrolysis of methyl acetate with hydrochloric acid.

b. Saponification of ethyl acetate.

c. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate

Books Recommended:

1. Vogel's; text book of Quantitative Inorganic Analysis (revised); Bassett, J.; Denney, R.C.; Jeffery, G. H and Mendham, J.; 6^{th} ed.; ELBS; 2007.
2. Experimental Inorganic Chemistry; Palmer, W.G.; Cambridge.
3. Analytical Chemistry; Christian, G. D.; 6^{th} ed.; Wiley; 2008.
4. Practical Physical Chemistry; Khosla, B. D.; Garg, V. C. & Gulati, A.; R. Chand & Co.; 2011.
5. Selected Experiments in Physical Chemistry; Mukherjee N.G.& Ghosh, J.N.; S. Chand & Sons.
6. Experiments in Physical Chemistry; Das, R. C, and Behra, B.; Tata McGraw Hill.
7. Advanced Practical Physical Chemistry; Yadav, J.B.; 20^{th} ed.; Goel Publishing House, 2001.

B.Sc. IVth Semester-Chemistry

Course No: **DSC-2D** ***Max. Marks: 80***
Course Weightage: 04 Credit ***End Term Exam: 60***
No. of Contact hours: 60 ***Continuous Assessment: 10***
Attendance: 10

Unit-I Coordination and Bioinorganic Chemistry: (16 Contact hours)

Coordination Chemistry:

Experimental verification of Werner's theory. Effective Atomic number: Concept and its significance.

Stereochemistry of Coordination compounds: With coordination numbers 2-6; Optical and Geometrical isomers of MA_4B_2, MA_3B_3 and MABCD type Complexes.

Bonding in Complexes**:** Comparison of valence bond and Crystal field theories; CFT of tetrahedral, square planner and octahedral systems. Factors affecting magnitude of Δ ; pairing energy and CFSE of weak and strong field ligands. Limitations of Crystal field theory. Applications of Coordination compounds. Jahn Teller Distortion.

Bioinorganic Chemistry:

Biomolecules and their Metal coordination behaviour: Proteins, Nucleic acids and Lipids. Abundance of elements in living systems; Concept and Criteria for essentiality of elements in living systems.

Distribution and biological role of essential elements in life: Na^+, K^+, Ca^{2+}, Mg^{2+}, Fe^{2+} and halogens.

Haemoglobin and Chlorophyl: Structural and Biological role.

Unit-II Amines and Nitrogen bearing Heterocyclic compounds:

(14 Contact hours)

Amines: Classification and factors affecting basicity of amines.Mechanistic detailes(wherever applicable) of methods of formation of alkyl and arylamines through reduction of nitro compounds and nitriles.Gabriel-Phthalamide reaction and Hofmann rearrangement. Mechanisms involved in the formation and reactions of arenediazonium salts including Azo coupling.

Heterocyclic compounds bearing one nitrogen atom: Stuctural features of pyrrole,pyrrolidine, pyridine and piperidine and comparative account of their basic strength.Aromaticity and electrophilic substitution reactions of pyrrole and their comparison with those of furan and thiophene.Mechanisms involved in the preparations of Indole and quinoline using Fischer-Indole and Bishlier-Napierlaski syntheses.

Unit-III States of Matter: (12 Contact hours)

Gaseous State: Deviation of gases from ideal behavior, van der Waal's equation of state.

Critical Phenomenon**:** PV isotherms of real gases, continuity of states, the isotherms of van der Waal's equation. Relationship between critical constants and van der Waal's 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.

Liquid State: Liquification of gases and adiabatic expansion. Intermolecular forces. Structure of liquids (a qualitative description), structural differences between solids, liquids and gases.

Solid State: Symmetry elements in crystals, Lattice planes and Miller indices. X-ray diffraction

by crystals, derivation of Bragg's equation and its application. Interplanar distances in terms of miller indices. Determination of crystal structure by Laue's method and powder method. Systematic absence of diffraction lines in the X-ray pattern of cubic crystals with reference to NaCl, KCl & CsCl.

Unit-IV Spectroscopy: (18 Contact hours)

***Spectroscopy*:** Electromagnetic radiation, regions of the spectrum, basic features of different spectrometers. Statement of Born-Oppenheimer approximation.

***Rotational spectrum*:** Moment of inertia, classification of molecules on the basis of moment of inertia. Energy of a rigid diatomic rotor, selection rules for rotational transition and associated spectrum, relative population of rotational levels and spectral intensity, determination of bond length.

Vibrational Spectrum: Classical and quantum mechanical (qualitative) treatment of simple harmonic oscillator, selection rules for vibrational transition, pure vibrational spectrum of a diatomic molecule, determination of force constant, relation of force constant with bond length and bond energy, vibrational degrees of freedom, idea of vibrational frequencies of different functional groups.

The infrared region, Molecular vibrations, significance of Hook's law and selection rules. The infrared spectrum. Fingerprint region and its significance. Effect of resonance, inductive effect and H-bonding on infrared absorptions. Characteristic absorptions of Alkanes, alkenes, alkynes, alcohols, ethers, carbonyl compounds, amines and carboxylic acids and their derivatives.

Ultraviolet Spectroscopy: The electromagnetic spectrum. Beer-Lambert law, molar absorptivity, presentation and analysis of electronic spectra. Types of electronic excitations. Effects of conjugation and solvents on absorption. Chromophores and auxochromes. Bathochromic and hypsochromic shifts. Ultraviolet spectra of enes and enones. Prediction of maxima of enes and enones using Woodward's rules.

Nuclear Magnetic Resonance Spectroscopy: Basic principles of NMR spectroscopy. Shielding and deshielding of protons. The chemical shift. Equivalent and non-equivalent protons. Spin-spin splitting, coupling constants for vicinal, geminal and long range couplings. Characteristic functional group NMR absorptions. The NMR spectra of ethyl bromide, ethanol, acetaldehyde, ethyl acetate, methyl propionate, toluene and acetophenone.

Books Recommended

1. Coordination Chemistry; Banerjee, D.; Tata Mc Graw Hill; 1997.
2. Concise Coordination Chemistry; Gopalan, R. & Ramalingam, V.; Vikas; 2003.
3. The Biological Chemistry of Elements; Frausto de Silva, J.J. R. & Williams, R.J.P.; Oxford; 1994.
4. Bio-inorganic Chemistry of Elements; Hussain Reddy, K.; New Age; 2005.
5. A textbook of Organic Chemistry; Bansal, R.K.; 4th ed.; Wiley Eastern; 2003.
6. Organic Chemistry; Morrison and Boyd ; 6th ed. ; PHI; 2003.
7. Fundamentals of Organic Chemistry; Solomons and Fryhle ; 10th ed.; John-Wiley; 2012.
8. Reaction Mechanism in Organic Chemistry; Mukherji and Singh; 3rd ed.; Macmillan; 2007.
9. Physical Chemistry; Barrow, G. M.; 5thed.; McGraw-Hill; International Student edition; 1992.
10. Physical Chemistry; Alberty , Selby et al; Wiley Eastern Ltd.
11. Fundamentals of Molecular Spectrsocopy; Banwell, C.N., E.M.Mc. Cash; 4th ed.; Tata McGrawHill; 1994.
12. Electronic Absorption Spectroscopy and related techniques; Sathyanarayna, D N; Universities Press.

B.Sc. IVth Semester-Chemistry

Course No:* DSC-2D Lab** ***Max. Marks: 20
Course Weightage: 02 Credit ***End Term Exam: 15***
No. of Contact hours: 30 ***Attendance : 05***

Section A: Inorganic Chemistry:

A. Gravimetry:

1. Estimation of Copper as CuSCN.
2. Estimation of Nickel as $[Ni(dmg)_2]$.
3. Estimation of Silver as AgCl.
4. Estimation of Barium as $BaSO_4$

B. Titrimetry:

1. Calibration of fractional weights and Analytical Labwares (Pipette, Burette, Volumetric Flask)
2. Preparation of Standard Solution (Oxalic-acid, Sodium Hydroxide, Potassium permanganate and Potassium dichromate)
3. Dilution of a Standard Solution (0.1M-0.001M).
4. Determination of Acetic acid concentrations in commercial Vinegar using NaOH.
5. Determination of alkali content in antacid tablets using HCl.
6. Determination of Calcium Content in chalk as Calcium Oxalate by Permanganometry.
7. Determination of Ferrous and Ferric ions by Dichromate method.
8. Estimation of hardness of water by EDTA.
9. Estimation of Copper using thiosulphate.

C. *Spectrophotometry:*

1. Spectrophotometric determination of Fe (II), using 1, 10-Phenanthroline
2. Spectrophotometric determination of Fe (III) with EDTA.

Section B: Organic Chemistry

A. Separation and Identification of binary mixtures of Organic Compounds:

Qualitative analysis of Organic mixture containing two solid components using H_2O, $NaHCO_3$ or NaOH for separation.

B. Synthesis of Organic Compounds (Any two of the following single stage preparations).

a) Acetylation of Salicylic acid
b) Preparation of Iodoform from acetone.
c) Preparation of m-dinitrobenzene from benzene.
d) Preparation of p-bromo acetanilide from acetanilide.

Section C: Physical Chemistry

A. Surface tension measurement (use of organic solvents excluded).

1. Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
2. Study of the variation of surface tension of a detergent solution with concentration.

B. Viscosity measurement (use of organic solvents excluded).

1. Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
2. Study of the variation of viscosity of an aqueous solution with concentration of solute.

C. Polarimetry:

1. To determine the angle of rotation and hence specific rotation of an optically active compound.
2. To study the kinetics of inversion of cane sugar.

D. Refractometry

1. To determine refractive index of a liquid by using Abbe's refractometer.
2. To determine percentage composition of a mixture of two liquids by refractometry (Glycerol and water).

Books Recommended:

1. Vogel's text book of Quantitative Inorganic Analysis (revised); Bassett, J., Denney, R.C., Jeffery, G. H and Mendham, J.; 6th ed.; ELBS; 2007.
2. Experimental Inorganic Chemistry; Palmer, W.G.; Cambridge.
3. Analytical Chemistry; Gary D-Christian; 6th ed.; Wiley; 2008.
4. Vogel's Textbook of Quantitative Inorganic Analysis; Bassett, J.; Denny, R.C; 6th ed.; ELBS; 2007.
5. *Vogel's Qualitative Inorganic Analysis;* Svehla, G.; Pearson Education; 2012.
6. *Vogel's Quantitative Chemical Analysis;* Mendham, J.; Pearson; 2009..
7. Vogel's book of Practical Organic Chemistry; Furniss, B.S., Hannaford, A.J.; Rogers, V.; Smith P.W.G.; 5th ed.; ELBS; 2009.
8. Laboratory manual in Organic Chemstry; Bansal, R.K.; Wiley Eastern.
9. Experimental Organic Chemistry; Singh, P.R.; Gupta, D.S. and K.S. Barpal; Vol I & II; Tata McGraw Hill.
10. *Comprehensive Practical Organic Chemistry;* Ahluwalia, V.K. & Aggarwal, R.; Universities Press.
11. *Practical Physical Chemistry;* Khosla, B. D.; Garg, V. C. & Gulati, A., Chand, R. & Co.; 2011.
12. Selected Experiments in Physical Chemistry; Mukherjee N.G.& Ghosh, J.N.; S. Chand & Sons.
13. Experiments in Physical Chemistry; Das, R. C, and Behra, B.; Tata McGraw Hill.