SYLLABUS FOR B.Sc. CHEMISTRY DEGREE PROGRAM UNDER CBCS W.E.F. 2017-18

Syllabus for

B.Sc. WITH CHEMISTRY

Programme

ANNEXURE - Ia: Semester-I Core Course (CC) of Chemistry ..... (1 Course)

DSC-2A

ANNEXURE - Ib: Semester-II Core Course (CC) of Chemistry ..... (1 Course)

DSC-2B

Syllabus of B.Sc. WITH CHEMISTRY
SEMESTER- I
CORE COURSE: DSC-2A
(6 credits: Theory-04, Practicals-02)
(Inorganic Chemistry & Organic Chemistry)

ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

Theory: 60 Lectures/60 Hours: (04 Credits)

Section A: Inorganic Chemistry-1 (30 Lectures: 02 Credits)

1. Atomic Structure: (**14 Lectures)**

Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.

What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Quantum numbers and their significance, Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms). Shapes of s, p and d atomic orbitals, nodal planes.

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

2. Chemical Bonding and Molecular Structure **(16 Lectures)**

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach, Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of Resonance and Resonating structures in various Inorganic and Organic compounds.

MO Approach, Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1^{st} and 2^{nd} periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO^{+}. Comparison of VB and MO approaches.

Section B: Organic Chemistry – I (30 Lectures: 02 Credits)

1. Fundamentals of Organic Chemistry (8 Lectures)

Curved arrow notation, drawing electron movement with arrows, half and double headed arrows, in organic reaction mechanisms.

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

2. Stereochemistry (10 Lectures)

Concept of isomerism. Types of isomerism. Stereoisomerism, conformational isomerism. 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 (for upto two C=C systems).

3. Aliphatic Hydrocarbons (12 Lectures)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) *Preparation:* Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$.

Reference Books:

Inorganic Chemistry

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.

Organic Chemistry

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
2. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
4. Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
5. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
6. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
7. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
8. Francis Carey, Organic Chemistry; 3rd Edition, Tata McGraw Hill India.

9. Paula Yurkanis Bruice, Organic Chemistry; 3rd Edition, Pearson Education Asia.
10. Jerry March, Advanced Organic Chemistry; 4rd Edition, John Wiley

CHEMISTRY LAB

DSC-2A LAB

(Inorganic Chemistry & Organic Chemistry)

Practicals: 60 Lectures/ 60 Hours :(02 credits)

Section A-(Inorganic Chemistry) (30 Hours: 01 Credit)

Volumetric Analysis: (5 x 6 Hours = 30 Hours)

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with standardised $KMnO_4$.
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) (30 Hours: 01 Credit)

1. Purification of organic compounds: **(2 x 4 Hours = 8Hours)**
   i) Solids by recrystallization process using water and ethanol as solvent. Determination of melting point.
   ii) Liquids by distillation process, a) acetone b) nitrobenzene. Determination of boiling point.
2. Determination of chemical type, detection of elements, group test for any one compound. **(4 Hours)**
3. Identification of unknown organic compounds. **(12 Hours)**
   i) Water insoluble solids (Acid, Base, Phenol and Neutral)
   ii) Water soluble solid (Acid and Neutral)
4. Thin layer chromatographic techniques: plate preparation, spotting, Separation of mixtures by thin layer Chromatography: Measure the Rf value in each case (combination of two compounds to be given eg. Mixture of o- and p-nitroaniline). **(6 Hours)**

Reference Books:

Inorganic Chemistry

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.

Organic Chemistry

1. 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.
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
3. Pandey, O.P., Bajpai D. N. & Giri S. *Practical Chemistry, Revised Edition*, (For BSc. I, II, III Year Students of All Indian Universities) S. Chand Company Pvt Limited, 2014.

Note: Practicals of 60 Hours = 30 Practicals of 2 hours each = 15 practicals of 4 hours each.
(Section A : 7.5 practicals and Section B : 7.5 practicals of 4 hours each)

Syllabus of B.Sc. WITH CHEMISTRY
SEMESTER- II
CORE COURSE: DSC-2B
(6 credits: Theory-04, Practicals-02)
(Physical Chemistry & Organic Chemistry)

CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY

Theory: 60 Lectures/ 60 Hours: (04 Credits)

Section A: Physical Chemistry- I (30 Lectures: 02 Credits)

1. Chemical Energetics (10 Lectures)

Need of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

2. Chemical Equilibrium: (8 Lectures)

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Definition of ΔG and ΔG^{o}, Le Chatelier's principle. Relationships between *Kp, Kc* and *Kx* for reactions involving ideal gases.

3. Ionic Equilibria: (12 Lectures)

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts.

Section B: Organic Chemistry – II (30 Lectures: 02 Credits)

1. Aromatic hydrocarbons (8 Lectures)

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

2. Alkyl and Aryl Halides (8 Lectures)

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions.

Preparation: from alkenes *and* alcohols.

Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation.
Elimination vs substitution.

Aryl Halides *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$).
Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

3. Alcohols, Phenols, Ethers and Carbonyl Compounds (14 Lectures)

Alcohols: *Preparation:* Preparation of 1^o, 2^o and 3^o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation *Diols:* oxidation of diols using HIO_4. Pinacol-Pinacolone rearrangement with mechanism.

Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts.

Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction.

Ethers (aliphatic and aromatic): Williamson's synthesis of ethers. Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic):
(Formaldehye, acetaldehyde, acetone and benzaldehyde)

Preparation: from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemmensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.

Reference Books:

Physical Chemistry

1. Bahl, A. & Bahl, B.S. *Advanced Physical Chemistry,* S. Chand, 2010.
2. J. N. Gurtu and Aayushi Gurtu, Undergraduate Physical Chemistry, Vol I, Vol II and Vol III Pragati Prakashan
3. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
4. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
5. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
6. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
7. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).

Organic Chemistry

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
2. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
4. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
5. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
6. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.
7. Francis Carey, Organic Chemistry; 3rd Edition, Tata McGraw Hill India.
8. Paula Yurkanis Bruice, Organic Chemistry; 3rd Edition, Pearson Education Asia.
9. Jerry March, Advanced Organic Chemistry; 4rd Edition, John Wiley.

CHEMISTRY LAB

DSC-2B LAB

(Physical Chemistry & Organic Chemistry)

Practicals: 60Lectures/ 60 Hours: (02 credits)

Section A-(Physical Chemistry) (30 Hours: 01 Credit)

Thermochemistry (Any three) **(6 x 3 = 18 Hours)**

1. Determination of heat capacity of calorimeter.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Study of the solubility of benzoic acid in water and determination of ΔH.

Chemical Kinetics: **(5x2=10 Hours)**

1. To study the effect of nature of reactants on the rate of reactions
2. Determination of relative strength between HCl and Urea hydrochloride for hydrolysis of methyl acetate

Ionic equilibria **(2x1=2 Hours)**

pH measurements

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.

Section B-(Organic Chemistry) (30 Hours: 01 Credit)

1. **Preparations**: Mechanisms involved in the following reactions to be discussed.

(1x2= 2 Hours)

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

Each preparation for **(7x4=28 hours)**

(a) Bromination of Phenol/Aniline (b) Benzoylation of amines/phenols

(c) 2,4-dinitrophenylhydrazone of benzaldehyde/acetophenone

(d) Nitration of acetanilide to p-nitroacetanilide. (e) Oxime of Cyclohexanone

(f) Chalcone from benzaldehyde and acetophenone (g) Iodoform from acetone

Reference books:

Physical Chemistry

1. S.W. Rajbhoj and T. K. Chondhekar, Systematic Experimental Physical Chemistry, Anjali Publication ,Second Edition 2000.
2. Sunita Rattan , Experiments in Applied Chemistry, S.K. Kataria & Sons ,Second edition, 2008
3. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
4. O. P. Pandey, D. N. Bajpai, S. Giri, Practical Chemistry, S. Chand Publication 2013
5. O. P. Virmani, A. K. Narula , Applied Chemistry Theory and Practice , New Age International Publishers, 2000.

Organic Chemistry

1. 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.
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
3. Pandey, O.P., Bajpai D. N. & Giri S. *Practical Chemistry, Revised Edition*, (For BSc. I, II, III Year Students of All Indian Universities) S. Chand Company Pvt Limited, 2014.
4. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: NewDelhi(2011).

Note: Practicals of 60 Hours = 30 Practicals of 2 hours each = 15 practicals of 4 hours each.

(Section A : 7.5 practicals and Section B : 7.5 practicals of 4 hours each)

Syllabus for

B.Sc. HONOURS WITH CHEMISTRY

Programme

ANNEXURE- IIa: Semester-I Core Course (CC) of Chemistry ..... (3 Courses)

DSC 1

DSC 2

DSC 3

ANNEXURE –IIb: Semester-I Generic Elective paper (GE)

of Chemistry …… .(1 Course)

GE-1

ANNEXURE- IIc: Semester-II Core Course (CC) of Chemistry ..... (3 Courses)

DSC 4

DSC 5

DSC 6

ANNEXURE- IId: Semester-II Generic Elective paper (GE)

of Chemistry…….. (1 Course)

GE-2

Syllabus of B.Sc. HONOURS WITH CHEMISTRY
SEMESTER- I
CORE COURSE: DSC 1
(6 credits: Theory-04, Practicals-02)
(Inorganic Chemistry)

Theory: 60 Lectures/ 60 Hours : (04 Credits)

Atomic Structure: (16 Lectures)

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f* orbitals. Contour boundary and probability diagrams.

Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

Periodicity of Elements: (18 Lectures)

s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to *s* and *p*-block.

a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.
b) Atomic radii (van der Waals)
c) Ionic and crystal radii.
d) Covalent radii (octahedral and tetrahedral)
e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.
f) Electron gain enthalpy, trends of electron gain enthalpy.
g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

Chemical Bonding: (26 Lectures)

i. *Ionic bond:* General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy.

ii. *Covalent bond:* Lewis structure, Valence Bond theory (Heitler-London approach).Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl, BeF_2, CO_2, (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths.

Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization.

Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

iii. *Metallic Bond:* Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.

iv. *Weak Chemical Forces:* van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process.

Reference Books:

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Douglas, B.E. and McDaniel, D.H. *Concepts & Models of Inorganic Chemistry* Oxford, 1970
3. Atkins, P.W. & Paula, J. *Physical Chemistry*, 10th Ed., Oxford University Press, 2014.
4. Day, M.C. and Selbin, J. *Theoretical Inorganic Chemistry*, ACS Publications, 1962.
5. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.

CHEMISTRY LAB
DSC 1 LAB
(Inorganic Chemistry)

Practicals : 60 Lectures/ 60 Hours : (02 Credits)

(A) Titrimetric Analysis (3 x 3 = 9 Hours)

i. Calibration and use of apparatus (Burette, pipette, Standard Volumetric flask)

ii. Preparation of solutions of different Molarity and Normality of titrants.

iii. Preparation of solution based on ppm, mole fraction and molality

(B) Acid-Base Titrations (4 x 4=16 Hours)

i. Estimation of carbonate and hydroxide present together in mixture.

ii. Estimation of carbonate and bicarbonate present together in a mixture.

iii. Estimation of free alkali present in different soaps.

iv. Estimation of free alkali present in different detergents.

(C) Oxidation-Reduction Titrimetry (4x 4=16 Hours)

i. Estimation of Fe(II) using standardized (0.05N) $KMnO_4$ solution.

ii. Estimation of oxalic acid using standardized (0.05N) $KMnO_4$ solution.

iii. Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine and anthranilic acid) and external indicator.

(D) Analysis of mixtures containing two cations and two anions (4 -5 mixtures)

(19 Hours)

Cations: Cu^{2+}, Cd^{+}, Sn^{+}, Fe^{2+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Ni^{2+}, Co^{2+}, Ca^{2+}, Ba^{2+}, Sr^{2+}, Mg^{2+}, NH_4^{+}, K^{+}

Anions: Cl^{-}, Br^{-}, I^{-},S^{2-} NO^{2-} NO_3, SO_4^{-2}, CO_3^{-2}.

Reference books:

1. Mendham, J., A. I. Vogel's *Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.
2. Vogel's *Qualitative Inorganic Analysis,* Revised by G. Svehla. Pearson Education, 2002.

Note: Practicals of 60 Hours = 15 practicals of 4 Hours each.

Syllabus of B.Sc. HONOURS WITH CHEMISTRY
SEMESTER- I
CORE COURSE: DSC 2
(6 credits: Theory-04, Practicals-02)
(Physical Chemistry-I)

Theory: 60 Lectures/60 Hours : (04 Credits)

Gaseous state: **(18 Lectures)**

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η.

Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy.

Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, *Z*, and its variation with pressure for different gases. Causes of deviation from ideal behaviour. Van der Waals equation of state, its derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dietrici); virial equation of state; van der Waals equation expressed in virial form and calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

Liquid state: **(6 Lectures)**

Qualitative treatment of the structure of the liquid state, physical properties of liquids; vapour pressure, surface tension and its determination. Effect of addition of various solutes on surface tension. Viscosity and its determination and coefficient of viscosity.

Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids. Intermolecular forces in liquids.

Solid state: **(16 Lectures)**

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Morphotropism and Polymorphism.

Ionic equilibria: **(20 Lectures)**

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids (exact treatment).

Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body.

Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations.

Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants.

Reference Books:

1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry* 10th Ed., Oxford University Press (2014).
2. Ball, D. W. *Physical Chemistry* Thomson Press, India (2007).
3. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
4. Mortimer, R. G. *Physical Chemistry* 3rd Ed. Elsevier: NOIDA, UP (2009).
5. Engel, T. & Reid, P. *Physical Chemistry* 3rd Ed. Pearson (2013).
6. J. N. Gurtu and Aayushi Gurtu , Undergraduate Physical Chemistry , Vol I, Vol II Vol III,

Pragati Prakashan Edition 2008.

7. K.L. Kapoor, Textbook of Physical Chemistry Vol I & II Third Edition, Macmillan India Ltd 2004

8. B.S. Bahl , A. Bhal , G. D . Tuli, Essentials of Physical Chemsitry, S. Chand & Company Edition 2006.

9. Gurudeep Raj, Advanced Physical Chemistry, Goel Publication

10. J. N. Gurtu, Advanced Physical Chemistry, Pragati Prakashan Edition

CHEMISTRY LAB

DSC 2 LAB
(Physical Chemistry-I)

Practicals : 60 Lectures/ 60 Hours: (02 Credits)

1. Surface tension measurements. (8 x 2 =16 Hours)

a. Determine the surface tension by drop number method

b. Study the variation of surface tension of detergent solutions with concentration.

2. Viscosity measurement using Ostwald's viscometer. (6 x 2=12 hours)

a. Determination of viscosity of aqueous solutions of (i) Ethanol and

(ii) Sugar at room temperature.

b. Study the variation of viscosity of sucrose solution with the concentration of solute.

3. Indexing of a given powder diffraction pattern of a cubic crystalline system.(2 Hours)

4. pH metry (6 x 5= 30 Hours)

a. Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.

b. Preparation of buffer solutions of different pH

i. Sodium acetate-acetic acid

ii. Citric acid and di sodium hydrogen phosphate

c. pH metric titration of (i) strong acid (HCl) vs. strong base (NaOH), (ii) weak acid (CH_3COOH) vs. strong base (NaOH).

d. Determination of dissociation constant of a weak acid (CH_3COOH)

Any other experiment carried out in the class.

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
2. S.W. Rajbhoj and T. K. Chondhekar, Systematic Experimental Physical Chemistry , Anjali Publication ,Second Edition 2000.

3. Sunita Rattan , Experiments in Applied Chemistry, S.K. Kataria & Sons ,Second edition ,2008
4. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
5. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry*

Note: Practicals of 60 hours = 15 practicals of 4 hours each

Syllabus of B.Sc. HONOURS WITH CHEMISTRY
SEMESTER- I
CORE COURSE: DSC 3
(6 credits: Theory-04, Practicals-02)
(Organic Chemistry-I)

Theory: 60 Lectures/ 60 Hours: (04 Credits)

Basics of Organic Chemistry **(6 Lectures)**

Organic Compounds: Classification and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties.

Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, Hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and relative stability of Carbocations, Carbanions, Free radicals, carbenes and benzynes.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Stereochemistry **(18 Lectures)**

Concept of isomerism. Types of isomerism. Stereoisomerism, Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions;
Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules.

Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

Chemistry of Aliphatic Hydrocarbons **(24 Lectures)**

A. Carbon-Carbon sigma bonds

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

B. Carbon-Carbon pi bonds:

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.

Reactions of alkynes: Acidity, and Nucleophilic Electrophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

C. Cycloalkanes and Conformational Analysis

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformational analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

Aromatic Hydrocarbons (12 Lectures)

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

Reference Books:

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).

2. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
4. Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education,2000.
5. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
6. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
7. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.
8. Francis Carey, Organic Chemistry; 3rd Edition, Tata McGraw Hill India.
9. Paula Yurkanis Bruice, Organic Chemistry; 3rd Edition, Pearson Education Asia.
10. Jerry March, Advanced Organic Chemistry; 4rd Edition, John Wiley.
11. Kalsi, P. S. *Stereochemistry Conformation and Mechanism*, New Age International, 2005.

CHEMISTRY LAB
DSC 3 LAB
(Organic Chemistry)

Practicals : 60 Lectures/ 60 Hours: (02 Credits)

1. Purification of organic compounds by crystallization using the following solvents: **(4 x 3=12 Hours)**
   a. Water
   b. Alcohol
   c. Alcohol-Water

   Determination of melting point and yield of the recrystallized product.

2. Distillation and determination of boiling point for the following: **(4 x 2=8 Hours)**

   Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method).

   a) Ethyl alcohol/Acetone b) Acetophenone/Nitrobenzene

   Determination of the volume of distilled product (optional)

3. Effect of impurities on the melting point – mixed melting point of two unknown organic Compounds**.** **(4 x2= 8 Hours)**

4. Identification of unknown organic compounds. **(6 x 4=24 Hours)**
   i. Water insoluble solids (Acid, Base, Phenol and Neutral)
   ii. Water soluble solid (Acid and Neutral)
   iii. Volatile liquids (2)
   iv. Non-volatile liquids (2)

5. Chromatography: **(4 x 2=8 Hours)**

Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC).

Reference Books:

1. 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.
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

3. Pandey, O.P., Bajpai D. N. & Giri S. *Practical Chemistry, Revised Edition*, (For BSc. I, II, III Year Students of All Indian Universities) S. Chand Company Pvt Limited, 2014.

Note: Practicals of 60 Hours = 15 Practicals of 4 hours each

Syllabus of B.Sc. HONOURS WITH CHEMISTRY
SEMESTER- I
GENERIC ELECTIVE PAPERS (GE) (Minor-Chemistry)
(4 Credits: Theory-04)
(Inorganic Chemistry & Organic Chemistry)

GE-1: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

Theory: 60 Lectures/60 Hours: (04 Credits)

Section A: Inorganic Chemistry-1 (30 Lectures: 02 Credits)

1. Atomic Structure: (**14 Lectures)**

Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.

What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers ml and ms. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

2. Chemical Bonding and Molecular Structure (16 Lectures)

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-

Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of Resonance and Resonating structures in various Inorganic and Organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1^{st} and 2^{nd} periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO^{+}. Comparison of VB and MO approaches.

Section B: Organic Chemistry-1 (30 Lectures: 02 Credits)

1. Fundamentals of Organic Chemistry (08 Lectures)

Curved arrow notation, drawing electron movement with arrows, half and double headed arrows, in organic reaction mechanisms. Physical Effects, Electronic Displacements: Concepts of Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation effects with one example each. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates in organic reactions Definitions and structure of Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

2. Stereochemistry (10 Lectures)

Concept of isomerism. Types of isomerism. Stereoisomerism, conformational isomerism. 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 (for upto two C=C systems).

3.Aliphatic Hydrocarbons (12 Lectures)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes anddehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytichydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$)and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition-Mechanism), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation (Only reactions).

Alkynes: (Upto 5 Carbons) *Preparation:* Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$

Reference Books:

Section A: Inorganic Chemistry

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.

Section B: Organic Chemistry

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
2. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).

4. Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
5. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
6. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
7. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
8. Francis Carey, *Organic Chemistry*; 3rd Edition, Tata McGraw Hill India.
9. Paula Yurkanis Bruice, *Organic Chemistry*; 3rd Edition, Pearson Education Asia.
10. Jerry March, *Advanced Organic Chemistry*; 4rd Edition, John Wiley.

OR

Syllabus of B.Sc. HONOURS WITH CHEMISTRY
SEMESTER- I
GENERIC ELECTIVE PAPERS (GE) (Minor-Chemistry)
(4 Credits: Theory-03, Practicals-01)

(Inorganic Chemistry & Organic Chemistry)
GE-1: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

Theory: 45 Lectures/ 45 Hours: (03 Credits)

Section A: Inorganic Chemistry-1 **(22 Lectures: 1.5 Credit)**

Atomic Structure: (06 Lectures)

Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.

What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Significance of quantum numbers, Shapes of s, p and d atomic orbitals. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Chemical Bonding and Molecular Structure: (16 Lectures)

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches.

Section B: Organic Chemistry-1 (23 Lectures: 1.5 credits)

Fundamentals of Organic Chemistry (07 Lectures)

Curved arrow notation, drawing electron movement with arrows, half and double headed arrows, in organic reaction mechanisms. Physical Effects, Electronic Displacements: Concepts of Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation effects with one example each. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates in organic reactions, definitions and structure of carbocations, carbanions and free radicals.

Stereochemistry (09 Lectures)

Concept of isomerism. Types of isomerism. Stereoisomerism, conformational isomerism. Conformations with respect to ethane. 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 (for upto two C=C systems).

Aliphatic Hydrocarbons (07 Lectures)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition-Mechanism),

Reference Books:

Section A :Inorganic Chemistry

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.

Section B : Organic chemistry

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
2. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
4. Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
5. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
6. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
7. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
8. Francis Carey, Organic Chemistry; 3rd Edition, Tata McGraw Hill India.
9. Paula Yurkanis Bruice, Organic Chemistry; 3rd Edition, Pearson Education Asia.
10. Jerry March, Advanced Organic Chemistry; 4rd Edition, John Wiley.

CHEMISTRY LAB
GE-1 LAB

GE-1 LAB: ATOMIC STRUCTURE, BONDING, GENERAL ORGANICCHEMISTRY & ALIPHATIC HYDROCARBONS
(Inorganic Chemistry & Organic Chemistry)

Practicals: 30 Lectures/ 30 Hours: (01 Credit)

Section A: Inorganic Chemistry 15 Hours (0.5 Credit)

Volumetric Analysis **(3 x 5 = 15 Hours)**

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 Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.

Section B: Organic Chemistry 15 Hours (0.5 Credit)

5. Purification of organic compounds. **(2 x 4 = 08 Hours)**

   iii) Solids by recrystallization process using water and ethanol as solvent. Determination of melting point.

   iv) Liquids by distillation process, a) acetone b) nitrobenzene. Determination of boiling point.

6. Determination of chemical type, detection of elements, group test for any five compounds. **(07 Hours)**

Reference Books :

Section A: Inorganic Chemistry

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.

Section B: Organic Chemistry

1. 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.
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
3. Pandey, O.P., Bajpai D. N. & Giri S. *Practical Chemistry, Revised Edition*, (For BSc. I, II, III Year Students of All Indian Universities) S. Chand Company Pvt Limited, 2014.

Note: Practicals of 30 Hours = 15 practicals of 2 hours each = 7.5 practicals of 4 hours each

Syllabus of B.Sc. HONOURS WITH CHEMISTRY
SEMESTER- II
CORE COURSE: DSC-4
(6 credits: Theory-04, Practicals-02)
(Physical Chemistry-II)

Theory: 60 Lectures/ 60 Hours: (04 Credits)

Chemical Thermodynamics: (36 Lectures)

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.

First law: Concept of heat, *q*, work, *w*, internal energy, *U* and statement of first law; enthalpy, *H*, relation between heat capacities. Calculations of *q*, *w*, *U* and *H* for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data.

Effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics;

Molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.

Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature.

Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

Systems of Variable Composition: (8 Lectures)

Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs- Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

Chemical Equilibrium: (8 Lectures)

Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants K_p, K_c and K_x. Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.

Solutions and Colligative Properties: (8 Lectures)

Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions.

Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

Reference Books:

6. Peter, A. & Paula, J. de. *Physical Chemistry* 10th Ed., Oxford University Press (2014).
7. Castellan, G. W. *Physical Chemistry 4th Ed.,* Narosa (2004).
8. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
9. McQuarrie, D. A. & Simon, J. D. *Molecular Thermodynamics* Viva Books Pvt. Ltd. New Delhi (2004).
10. Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. *Commonly Asked Questions in Thermodynamics.* CRC Press: NY (2011).
11. Levine, I .N. *Physical Chemistry* 6th Ed., Tata Mc Graw Hill (2010).
12. Metz, C.R. *2000 solved problems in chemistry,* Schaum Series (2006).

13. K.L. Kapoor, Textbook of Physical Chemistry Vol I & II Third Edition, Macmillan India Ltd 2004
14. B.S. Bahl , A. Bhal , G. D . Tuli, Essentials of Physical Chemsitry, S. Chand & Company Edition 2006
15. Gurudeep Raj, Advanced Physical Chemistry, Goel Publication
16. J. N. Gurtu, Advanced Physical Chemistry, Pragati Prakashan Edition
17. J. N. Gurtu, A. Gurtu Undergraduate Physical Chemistry, Vol I, Vol II and Vol II , Pragati Prakashan Second edition 2008

CHEMISTRY LAB
DSC 4 LAB
(Physical Chemistry-II)

Practicals : 60 Lectures/ 60 Hours: (02 Credits)

Thermochemistry (Any 4) **(8x4=32 Hours)**

a) Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).

b) Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

c) Calculation of the enthalpy of ionization of ethanoic acid.

d) Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.

e) Study of the solubility of benzoic acid in water and determination of ΔH.

Chemical Kinetics: **(8x3=24 Hours)**

1. To study the effect of nature of reactants on the rate of reactions
2. To determine degree of hydrolysis of urea hydrochloride and HCl
3. To determine energy of activation for the hydrolysis of methyl acetate at two different temperatures

Polarimetry: **(4x1= 4 Hours)**

1. To determine the concentration of a given solution of an optically active substance of sucrose.

Any other experiment carried out in the class.

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry , R. Chand & Company, New Delhi 2011*
2. *Athawale , V. D and Mathur P. Experimental Physical Chemistry, New Age International New Delhi 2001*
3. *S.W. Rajbhoj and T. K. Chondhekar, Systematic Experimental Physical Chemistry, Anajani Publication,Second Edition 2000*
4. *O. P. Virmani, A.K. Narula, Applied Chemistry Theory and Practice. New Age International Publishers, 2000*

Note: Practicals of 60 Hours = 15 Practicals of 4 hours each

Syllabus of B.Sc. HONOURS WITH CHEMISTRY
SEMESTER- II
CORE COURSE: DSC-5
(6 credits: Theory-04, Practicals-02)
(Inorganic Chemistry)

Theory: 60 Lectures/ 60 Hours: (04 Credits)

Acids and Bases **(10 Lectures)**

Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle.

Chemistry of *s* and *p* Block Elements: **(30 Lectures)**

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of *s* and *p* block elements.

Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate.

Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses.

Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

Noble Gases: **(10 Lectures)**

Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF_2, XeF_4 and XeF_6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF_2). Molecular shapes of noble gas compounds (VSEPR theory).

Inorganic Polymers: (10 Lectures)

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.

Reference Books:

1. Lee, J.D. *Concise Inorganic Chemistry*, ELBS, 1991.
2. Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. *Concepts & Models of Inorganic Chemistry 3rd Ed.*, John Wiley Sons, N.Y. 1994.
3. Greenwood, N.N. & Earnshaw. *Chemistry of the Elements*, Butterworth-Heinemann. 1997.
4. Cotton, F.A. & Wilkinson, G. *Advanced Inorganic Chemistry*, Wiley, VCH, 1999.
5. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.
6. Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry* 4th Ed., Pearson, 2010.
7. Atkin, P. *Shriver & Atkins' Inorganic Chemistry* 5th Ed. Oxford University Press (2010).

CHEMISTRY LAB
DSC 5 LAB
(Inorganic Chemistry-II)

Practicals : 60 Lectures/ 60Hours: (02 Credits)

(A) Gravimetric Analysis (5 x 3 =15 Hrs)

1. Determination of the percentage composition of the following mixtures

   $NH_4Cl + BaSO_4$

   $ZnO + ZnCO_3$

2. Gravimetric Estimation of Ba as $BaSO_4$

(B) Inorganic preparations (5 x3 = 15 Hrs)

(i) Cuprous Chloride, Cu_2Cl_2

(ii) Preparation of Manganese(III) phosphate, $MnPO_4.H_2O$

(iii) Preparation of Aluminium potassium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum) or Chrome alum.

(C) Analysis of mixtures containing two cations and two anions(4-5 mixtures) (18 Hrs)

Cations: Cu^{2+}, Cd^{2+}, Sn^{2+}, Fe^{2+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Ni^{2+}, Co^{2+}, Ca^{2+}, Ba^{2+}, Sr^{2+}, Mg^{2+}, NH_4^{+}, K^{+}

Anions: Cl^{-}, Br^{-}, I^{-},S^{2-} NO^{2-} NO_3, SO_4^{-2}, CO_3^{-2}.

(D) Double burette titration **(4 x 3 = 12 Hrs)**

(i) to prepare 100 ml of 0.05N anhydrous Sodium Carbonate and to standardise given HCl (aprox 0.1 N) and then to prepare 100 ml of 0.05N HCl from the standardised HCl solution.

(ii) To prepare 100 ml of 0.055N Borax and to standardise given H_2SO_4 (aprox 0.1 N) and then to prepare 100 ml of 0.045N H_2SO_4 from the standardised H_2SO_4 solution.

(iii) To prepare 100 ml of 0.045N KHP and to standardise given NaOH (aprox 0.1 N) and then to prepare 100 ml of 0.05N NaOH from the standardised NaOH solution

Reference Books:

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.

2. Vogel's *Qualitative Inorganic Analysis*, Revised by G. Svehla. Pearson Education,2002.

Note: Practicals of 60 Hours = 15 Practicals of 4 hours each

Syllabus of B.Sc. HONOURS WITH CHEMISTRY
SEMESTER- II
CORE COURSE: DSC-6
(6 credits: Theory-04, Practicals-02)
(Organic Chemistry-II)

Theory: 60 Lectures/60 Hours: (04 Credits)

Chemistry of Halogenated Hydrocarbons: (16 Lectures)

Alkyl halides: Methods of preparation, nucleophilic substitution reactions – SN1, SN2 and SNi mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination.

Aryl halides: Preparation, including preparation from diazonium salts. nucleophilic aromatic substitution; SNAr, Benzyne mechanism.

Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Organometallic compounds of Mg and Li – Grignard synthesis of alcohols and organolithium reagents to synthesize ketones.

Alcohols, Phenols, Ethers and Epoxides: (16 Lectures)

Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement with mechanism.

Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism;

Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$.

Carbonyl Compounds: (14 Lectures)

Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer

Villiger oxidation, α-substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, Meerwein-Pondorf Verley reduction, Oxidation with Pyridinium Dichromate and Pyridinium Chlorochromate);

Addition reactions of unsaturated carbonyl compounds: Michael addition.

Active methylene compounds: Keto-enol tautomerism. Preparation of ethyl malonate and ethyl acetoacetate. Applications: Malonic ester to carboxylic acids and ethylacetoacetate to ketones.

Carboxylic Acids and their Derivatives: (10 Lectures)

Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids;

Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann bromamide degradation and Curtius rearrangement.

OrganoSulphur compounds: (4 Lectures)

Preparation and reactions of thiols, thioethers and sulphonic acids.

Reference Books:

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
2. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
4. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
5. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
6. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
7. Francis Carey, Organic Chemistry; 3rd Edition, Tata McGraw Hill India.
8. Paula Yurkanis Bruice, Organic Chemistry; 3rd Edition, Pearson Education Asia.
9. Jerry March, Advanced Organic Chemistry; 4rd Edition, John Wiley.

CHEMISTRY LAB
DSC 6 LAB
(Organic Chemistry-II)

Practicals : 60 Lectures /60 Hours: (02 Credits)

1. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.

(6 x 1 = 6 Hours)

2. Organic preparations:

Expts. i to vi **(4 x 6= 24Hours)**

Expts. vii to xi **(6 x 5 =30 Hours)**

i. Acetylation of **one** of the following compounds: amines (aniline, *o*-, *m*-, *p*-toluidines and *o*-, *m*-, *p*-anisidine) and phenols (β-naphthol, vanillin, salicylic acid) by **Any one** method:
   a. Using conventional method.
   b. Using green approach

ii. Benzoylation of **one** of the following amines (aniline, *o*-, *m*-, *p*- toluidines and *o*-, *m*-, *p*-anisidine) and **one** of the following phenols (β-naphthol, resorcinol, p-cresol) by Schotten-Baumann reaction.

iii. Oxidation of ethanol/ isopropanol (Iodoform reaction).

iv. Bromination of **Any one** of the following:
   a. Acetanilide by conventional methods
   b. Acetanilide using green approach (Bromate-bromide method)

v. Nitration of **any one** of the following:
   a. Acetanilide/nitrobenzene by conventional method
   b. Salicylic acid by green approach (using ceric ammonium nitrate).

vi. Selective reduction of *meta* dinitrobenzene to *m*-nitroaniline.

vii. Reduction of *p*-nitrobenzaldehyde/benzaldehyde by sodium borohydride.

viii. Hydrolysis of amides (benzamide).

ix. Osazone preparation from glucose and phenyl hydrazine hydrochloride.

x. Aldol condensation using either conventional or green method.

xi. Benzil-Benzilic acid rearrangement.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid

samples must be collected and **may be** used for recrystallization, melting point and TLC.

.**Reference Books:**

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009)
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.* Pearson (2012).
3. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis,* University Press (2000).
4. Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis,* University Press (2000)

Note: Practicals of 60 Hours = 15 Practicals of 4 hours each

Syllabus of B.Sc. HONOURS WITH CHEMISTRY
SEMESTER- II
GENERIC ELECTIVE PAPERS (GE) (Minor-Chemistry)
(4 Credits: Theory-04)
(Physical Chemistry & Organic Chemistry)

GE-2: CHEMICAL ENERGETICS, EQUILIBRIA &FUNCTIONAL ORGANIC CHEMISTRY –I

Theory: 60 Lectures/ 60 Hours : (04 Credits)

Section A: Physical Chemistry-1 (30 Lectures: 02 Credits)

Chemical Energetics **(10 Lectures)**

Need of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution.

Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data.

Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Chemical Equilibrium: **(08 Lectures)**

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Definition of ΔG and ΔG^{o}, Le Chatelier's principle. Relationships between *Kp, Kc* and *Kx* for reactions involving ideal gases.

Ionic Equilibria: **(12 Lectures)**

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts.

Section B: Organic Chemistry-2 (30 Lectures: 02 Credits)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons (**8 Lectures)**

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic aromatic substitution: Benzene to nitrobenzene, benzene sulphonic acid, chlorobenzene. Friedel- Crafts reaction (alkylation and acylayion) (upto 4 carbons on benzene)

Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

Alkyl and Aryl Halides **(8 Lectures)**

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions.

Preparation: from alkenes *and* alcohols.

Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Rate of reactivity of nitrochloroarenes towards nucleohilic aromatic substitution. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$).

Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Alcohols, Phenols, Ethers and Carbonyl compounds (**14 Lectures)**

Alcohols: *Preparation:* Synthesis of primary, secondary and tertiary alcohols using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation *Diols:* Oxidation of diols using HIO_4.

Pinacol-Pinacolone rearrangement with mechanism.

Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts.

Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction (Mechanism), Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten –

Baumann Reaction. (Only reactions with application)

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic):

(Formaldehye, acetaldehyde, acetone and benzaldehyde)

Preparation: from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation (Mechanism), Cannizzaro's reaction, Wittig reaction, Benzoin condensation (mechanism). Clemmensen reduction and Wolff Kishner reduction with mechanistic and reactivity comparisons. Meerwein-Pondorff Verley reduction.

Reference Books:

Section A: Physical Chemistry

1. Bahl, A. & Bahl, B.S. *Advanced Physical Chemistry,* S. Chand, 2010.
2. J. N. Gurtu and Aayushi Gurtu, Undergraduate Physical Chemistry, Vol I, Vol II and Vol III Pragati Prakashan Edn. 2008
3. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
4. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
5. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
6. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
7. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
8. K.L. Kapoor, Textbook of Physical Chemistry Vol I & II Third Edition, Macmillan India Ltd 2004
9. B.S. Bahl, A. Bhal , G. D . Tuli, Essentials of Physical Chemistry, S. Chand & Company Edition 2006
10. Gurudeep Raj, Advanced Physical Chemistry, Goel Publication
11. J. N. Gurtu, Advanced Physical Chemistry, Pragati Prakashan Edition

Reference Books:

Section B: Organic Chemistry

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
2. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
4. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
5. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
6. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
7. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
8. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
9. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
10. Francis Carey, Organic Chemistry; 3rd Edition, Tata McGraw Hill India.
11. Paula Yurkanis Bruice, Organic Chemistry; 3rd Edition, Pearson Education Asia.
12. Jerry March, Advanced Organic Chemistry; 4rd Edition, John Wiley.

OR

Syllabus of B.Sc. HONOURS WITH CHEMISTRY

SEMESTER- II

GENERIC ELECTIVE PAPERS (GE) (Minor-Chemistry)

(4Credits: Theory-03, Practicals-01)

(Physical Chemistry & Organic Chemistry)

Theory: 45 Lectures/ 45 Hours: (03 Credits)

Section A: Physical Chemistry (23 Lectures: 1.5 Credits)

Chemical Energetics **(10 Lectures)**

Need of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution.

Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data.

Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Statement of Third Law of thermodynamics and calculation of absolute entropies of substances

Ionic Equilibria: **(13 Lectures)**

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts.

Section B: Organic Chemistry-2 (22 Lectures: 1.5 Credits)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons **(7 lectures)**

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic aromatic substitution: Benzene to nitrobenzene, benzene sulphonic acid, chlorobenzene. Friedel Crafts alkylation to convert benzene to toluene, and Friedel Crafts acylation to convert benzene to acetophenone.

Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

Alkyl and Aryl Halides (7 Lectures)

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions.

Preparation: from alkenes *and* alcohols.

Reactions: Williamson'sether synthesis: Elimination vs substitution.

Aryl Halides *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$).

Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Alcohols, Phenols, Ethers and Carbonyl compounds (8 Lectures)

Alcohols: *Preparation:* Synthesis of primary, secondary and tertiary alcohols using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$,). Oppeneauer oxidation *Diols:*. Pinacol-Pinacolone rearrangement

Phenols: (Phenol case) *Preparation:* from diazonium salts.

Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction (Mechanism), Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten –Baumann Reaction. (Only reactions with application)

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic):

(Formaldehye, acetaldehyde, acetone and benzaldehyde)

Preparation: from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation (Mechanism), Cannizzaro's reaction, Wittig reaction, Benzoin condensation.

Reference Books:

Section A: Physical Chemistry

1. Bahl, A. & Bahl, B.S. *Advanced Physical Chemistry*, S. Chand, 2010.
2. J. N. Gurtu and Aayushi Gurtu, Undergraduate Physical Chemistry, Vol I, Vol II and Vol III Pragati Prakashan. Edn. 2008
3. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
4. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
5. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
6. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
7. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985)
8. K.L. Kapoor, Textbook of Physical Chemistry Vol I & II Third Edition, Macmillan India Ltd 2004
9. B.S. Bahl , A. Bhal , G. D . Tuli, Essentials of Physical Chemsitry, S. Chand & Company Edition 2006
10. Gurudeep Raj, Advanced Physical Chemistry, Goel Publication
11. J. N. Gurtu, Advanced Physical Chemistry, Pragati Prakashan Edition

Section B: Organic Chemistry

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
2. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
4. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
5. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
6. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
7. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
8. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).

9. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
10. Francis Carey, Organic Chemistry; 3rd Edition, Tata McGraw Hill India.
11. Paula Yurkanis Bruice, Organic Chemistry; 3rd Edition, Pearson Education Asia.
12. Jerry March, Advanced Organic Chemistry; 4rd Edition, John Wiley.

CHEMISTRY LAB

GE-2 LAB

GE-2 LAB: CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY
(Physical Chemistry & Organic Chemistry)

Practicals: 30 Lectures/ 30 Hours: (01 Credit)

Section A: Physical Chemistry (15 Hours: 0.5 Credit)

Thermochemistry (Any two) **2 X 4 .5 =9 hour**

1. Determination of heat capacity of calorimeter.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Study of the solubility of benzoic acid in water and determination of ΔH.

Chemical Kinetics: **2 X 3= 6 hours**

3. Study the effect of nature of reactants on the rate of reactions
4. Determination of relative strength between HCl and Urea Hydrochloride for hydrolysis of methyl acetate

Section B : Organic Chemistry (15 Hours: 0.5 Credit)

Preparations: Mechanisms involved in the following reactions to be discussed. **(3 hours)**

Recrystallisation, determination of melting point and calculation of quantitative yields to be done. **(3 x 4 = 12hours)**

(a) Bromination of Phenol/Aniline (b) Benzoylation of amines/phenols

(c) 2,4-dinitrophenylhydrazone of benzaldehyde/acetophenone

Reference Books:

Section A: Physical Chemistry

1. S.W. Rajbhoj and T. K. Chondhekar, Systematic Experimental Physical Chemistry, Anjali Publication ,Second Edition 2000.
2. Sunita Rattan , Experiments in Applied Chemistry, S.K. Kataria& Sons, Second edition ,2008

3. Khosla, B. D.; Garg, V. C. &Gulati, A. *Senior Practical Physical Chemistry*, R.Chand & Co.: New Delhi (2011).
4. O. P. Pandey, D. N. Bajpai, S. Giri, Practical Chemistry, S. Chand Publication 2013
5. O. P. Virmani, A. K. Narula , Applied Chemistry Theory and Practice , New Age International Publishers, 2000.

Reference Books:

Section B: Organic Chemistry

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.
5. Pandey, O.P., Bajpai D. N. & Giri S. *Practical Chemistry, Revised Edition*, (For BSc. I, II, III Year Students of All Indian Universities) S. Chand Company Pvt Limited, 2014.
6. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

Note: Practicals of 30 Hours = 15 practicals of 2 hours each = 7.5 practicals of 4 hours each

Pattern of Question Papers

for

Semester End Examination (SEE) and

Scheme of marking

ANNEXURE- IIIa: Pattern for Semester-I and Semester-II Core Courses **(CC)**

SEE Question Papers of **B.Sc. WITH CHEMISTRY** Programme.

Semester-I DSC-2A for 4 Credits

Semester-II DSC-2B for 4 Credits

ANNEXURE- IIIb: Pattern for Semester- I and Semester-II Core Courses **(CC)**

SEE Question Papers of **B.Sc. HONOURS WITH CHEMISTRY** Programme.

Semester-I DSC 1, DSC 2, DSC 3 for 4 Credits each

Semester-II DSC 4, DSC 5, DSC 6 for 4 Credits each

ANNEXURE -IIIc: Pattern for Semester-I and Semester-II Generic Elective **(GE**)

SEE Question Papers of **B.Sc. HONOURS WITH CHEMISTRY** Programme.

Semester-I GE-1 for 4 Credits for (4+0) option

GE-1 for **3 Credits** for (3+1) option

Semester-II GE-2 for 4 Credits for (4+0) option

GE-2 for **3 Credits** for (3+1) option

PAPER PATTERN FOR CORE COURSE PAPERS OF B.Sc. WITH CHEMISTRY PROGRAMME

Semester -I

B.Sc. WITH CHEMISTRY

Inorganic Chemistry and Organic Chemistry
Core Course: (DSC-2A)

Time Duration: 2 Hours **Total Marks: 80**

Section A: Inorganic Chemistry-1 Marks: 40

Q.1. Answer **any five** from the following **(2 x 5 = 10 Marks)**

i. Atomic structure
ii. Atomic structure
iii. Atomic structure
iv. Chemical bonding and Molecular structure
v. Chemical bonding and Molecular structure
vi. Chemical bonding and Molecular structure
vii. Chemical bonding and Molecular structure

Q.2. A. Answer the following

i) Chemical bonding and Molecular structure **4 Marks**
ii) Atomic structure **3 Marks**

OR

Q.2. A. iii) Chemical bonding and Molecular structure **4 Marks**
iv) Atomic structure **3 Marks**

Q.2.B.i) Atomic structure **4 Marks**
ii) Chemical bonding and Molecular structure **4 Marks**

Q.3. A. Answer the following

i) Chemical bonding and Molecular structure **4 Marks**
ii) Atomic structure **3 Marks**

OR

Q.3. A. iii) Chemical bonding and Molecular structure **4 Marks**

iv) Atomic structure **3 Marks**

Q.3.B i) Atomic structure **4 Marks**

ii) Chemical bonding and Molecular structure **4 Marks**

Section B: Organic Chemistry-1 Marks: 40

Q.4. Answer <u>any five</u> questions of the following. **(2 x 5=10 marks)**

i. Fundamentals of Organic Chemistry
ii. Stereochemistry
iii. Aliphatic hydrocarbons
iv. Fundamentals of Organic Chemistry
v. Aliphatic hydrocarbons
vi. Stereochemistry
vii. Aliphatic hydrocarbons

Q.5.A. i) Fundamentals of Organic Chemistry **4 marks**

ii) Aliphatic hydrocarbons **3 marks**

OR

iii) Fundamentals of Organic Chemistry **4 marks**

iv) Aliphatic hydrocarbons **3 marks**

Q.5.B. i) Stereochemistry **4 marks**

ii) Aliphatic hydrocarbons **4 marks**

Q.6.A. i) Stereochemistry **4 marks**

ii) Aliphatic hydrocarbons **3 marks**

OR

iii) Stereochemistry **4 marks**

iv) Aliphatic hydrocarbons **3 marks**

Q.6.B. i) Stereochemistry **4 marks**

ii) Fundamentals of Organic Chemistry **4 marks**

Note: Examiners may give sub-questions depending upon weightage of marks and proportionate answer expected.

Semester -II
B.Sc. WITH CHEMISTRY
Physical Chemistry and Organic Chemistry
Core Course: (DSC-2B)

Time Duration: 2 Hours **Total Marks: 80**

Section A: Physical Chemistry-1 Marks: 40

Q.1.Answer **any five** of the following**:** **(2x5=10 marks)**

i. Chemical Energetics.
ii. Chemical Equilibrium.
iii. Ionic Equilibria.
iv. Chemical Energetics.
v. Chemical Equilibrium.
vi. Ionic Equlibria.
vii. Ionic Equilibria

Q.2.A. i) Ionic Equilibria. **4 marks**

ii) Ionic Equlibria. **3 marks**

OR

Q.2.A. iii) Ionic Equilibria. **4 marks**

iv) Ionic Equlibria. **3 marks**

Q.2.B. i) Chemical Equilibrium **4 marks**

ii) Chemical Equilibrium **4 marks**

Q.3.A.i) Chemical Energetics. **4 marks**

ii) Chemical Energetics. **3 marks**

OR

Q.3.A. iii) Chemical Energetics. **4 marks**

iv) Chemical Energetics. **3 marks**

Q.3.B. i) Chemical Equilibrium **4 marks**

ii) Ionic Equilibria **4 marks**

Section B: Organic Chemistry 40 Marks

Q.4. Answer any five questions of the following. **(2 x 5 = 10 marks)**

i. Aromatic hydrocarbons
ii. Alkyl and aryl halides
iii. Alcohols, phenols, ethers and carbonyl compounds
iv. Alcohols, phenols, ethers and carbonyl compounds
v. Alkyl and aryl halides
vi. Alcohols, phenols, ethers and carbonyl compounds
vii. Aromatic hydrocarbons

Q.5.A. i) Aromatic hydrocarbons **4 marks**

ii) Alcohols, phenols, ethers and carbonyl compounds **3 marks**

OR

iii) Aromatic hydrocarbons **4 marks**

iv) Alcohols, phenols, ethers and carbonyl compounds **3 marks**

Q.5.B. i) Alkyl and aryl halides **4 marks**

ii) Alcohols, phenols, ethers and carbonyl compounds **4 marks**

Q.6.A. i) Alkyl and aryl halides **4 marks**

ii) Alcohols, phenols, ethers and carbonyl compounds **3 marks**

OR

iii) Alkyl and aryl halides **4 marks**

iv) Alcohols, phenols, ethers and carbonyl compounds **3 marks**

Q.6. B. i) Aromatic hydrocarbons **4 marks**

ii) Alcohols, phenols, ethers and carbonyl compounds **4 marks**

Note: Examiners may give sub-questions depending upon weightage of marks and proportionate answer expected.

PAPER PATTERN FOR CORE COURSE PAPERS OF B.Sc. HONOURS WITH CHEMISTRY PROGRAMME

Semester –I

B.Sc. HONOURS WITH CHEMISTRY

Inorganic Chemistry-I

Core Course: (DSC 1)

Time Duration: 2 Hours **Total Marks: 80**

Q.1. Answer **any five** from the following: (**4 x 5 = 20 Marks**)

i. Atomic structure
ii. Periodicity of elements
iii. Periodicity of elements
iv. Chemical bonding
v. Chemical bonding
vi. Chemical bonding
vii. Chemical bonding

Q.2. A. Answer the following:

i. Atomic structure **4 Marks**
ii. Periodicity of elements **3 Marks**

OR

Q.2. A. Answer the following:

iii. Atomic structure **4 Marks**
iv. Periodicity of elements **3 Marks**

Q.2. B. Answer the following:

i. Chemical bonding **4 Marks**
ii. Chemical bonding **4 Marks**

Q.3. A. Answer the following:

i. Periodicity of elements **4 Marks**
ii. Atomic structure **3 Marks**

OR

Q.3. A. Answer the following

i. Periodicity of elements **4 Marks**

ii. Atomic structure **3 Marks**

Q.3. B. Answer the following

i. Chemical bonding **4 Marks**

ii. Chemical bonding **4 Marks**

Q.4. A. Answer the following

i. Chemical bonding **4 Marks**

ii. Atomic structure **3 Marks**

OR

Q.4. A. Answer the following

i. Chemical bonding **4 Marks**

ii. Atomic structure **3 Marks**

Q.4. B. Answer the following

i. Periodicity of elements **4 Marks**

ii. Chemical bonding **4 Marks**

Q.5. A. Answer the following

i. Periodicity of elements **4 Marks**

ii. Atomic structure **3 Marks**

OR

Q.5. A. Answer the following

iii. Periodicity of elements **4 Marks**

iv. Atomic structure **3 Marks**

Q.5. B. Answer the following

i. Chemical bonding **4 Marks**

ii. Chemical bonding **4 Marks**

Note: Examiners may give sub-questions depending upon weightage of marks and proportionate answer expected.

Semester -I
B.Sc. HONOURS WITH CHEMISTRY
Physical Chemistry-I
Core Course: (DSC 2)

Time Duration: 2 Hours **Total Marks: 80**

Q.1. Answer **any five** of the following: **(4 x 5=20 Marks)**

i. Gaseous State
ii. Liquid State
iii. Solid State
iv. Ionic Equilibria
v. Gaseous Sate
vi. Solid State
vii. Ionic Equilibria

Q.2.A. i) Ionic Equilibria **4 marks**

ii) Ionic Equlibria **3 marks**

OR

Q.2.A. iii) Ionic Equilibria. **4 marks**

iv) Ionic Equlibria. **3 marks**

Q.2.B. i) Solid State **4 marks**

ii) Solid State **4 marks**

Q.3.A i) Gaseous State. **4 marks**

ii) Gaseous State **3 marks**

OR

Q.3.A iii) Gaseous state **4 marks**

iv) Gaseous state. **3 marks**

Q.3.B. i) Ionic Equilibria **4 marks**

ii) Ionic Equilibria **4 marks**

Q.4.A. i) Solid State. **4 marks**

ii) Solid State **3 marks**

OR

Q.4.A. iii) Solid State **4 marks**

iv) Solid State **3 marks**

Q.4.B. i) Gaseous State **4 marks**

ii) Gaseous State **4 marks**

Q.5.A. i) Gaseous State. **4 marks**

ii) Ionic Equilibria **3 marks**

OR

Q.5.A. iii) Ionic Equilibia **4 marks**

iv) Ionic Equilibia **3 marks**

Q.5.B. i) Liquid State **4 marks**

ii) Liquid State **4 marks**

Note: Examiners may give sub-questions depending upon weightage of marks and proportionate answer expected.

Semester -I
B.Sc. HONOURS WITH CHEMISTRY
Organic Chemistry-I
Core Course: (DSC 3)

Time Duration: 2 Hours **Total Marks: 80**

Q1) Answer **any five** questions of the following: **(4 x 5=20 marks)**

i. Basics in Organic Chemistry
ii. Stereochemistry
iii. Chemistry of aliphatic hydrocarbons
iv. Aromatic hydrocarbons
v. Chemistry of Aliphatic hydrocarbons
vi. Stereochemistry
vii. Chemistry of Aliphatic hydrocarbons

Q.2.A. i) Basics in Organic Chemistry **4 marks**
ii) Stereochemistry **3 marks**

OR

Q.2.A. iii) Chemistry of aliphatic hydrocarbons **4 marks**
iv) Stereochemistry **3 marks**

Q.2. B. i) Stereochemistry **4 marks**
ii) Aromatic hydrocarbons **4 marks**

Q.3.A. i) Stereochemistry **4 marks**
ii) Chemistry of aliphatic hydrocarbons **3 marks**

OR

Q.3.A. iii) Stereochemistry **4 marks**
iv) Chemistry of aliphatic hydrocarbons **3 marks**

Q.3.B. i) Basics in organic chemistry **4 marks**
ii) Chemistry of aliphatic hydrocarbons **4 marks**

Q.4.A. i) Stereochemistry **4 marks**
ii) Chemistry of aliphatic hydrocarbons **3 marks**

OR

Q.4.A. iii) Stereochemistry **4 marks**
iv) Aromatic hydrocarbons **3 marks**

Q.4.B. i) Aromatic hydrocarbons **4 marks**
ii) Aromatic hydrocarbons **4 marks**

Q.5.A. i) Chemistry of aliphatic hydrocarbons **4 marks**
ii) Stereochemistry **3 marks**

OR

Q.5.A. iii) Chemistry of aliphatic hydrocarbons **4 marks**
iv) Chemistry of aliphatic hydrocarbons **3 marks**

Q.5.B. i) Chemistry of aliphatic hydrocarbons **4 marks**
ii) Aromatic hydrocarbons **4 marks**

Note: Examiners may give sub-questions depending upon weightage of marks and proportionate answer expected.

Semester -II
B.Sc. HONOURS WITH CHEMISTRY
Physical Chemistry-II
Core Course: (DSC 4)

Time Duration: 2 Hours **Total Marks: 80**

Q.1. Answer **any five** of the following: **(4 x 5=20 Marks)**

i. Chemical Thermodynamics.
ii. System of Variable Composites.
iii. Chemical Equilibrium.
iv. Solution and Colligative properties.
v. Chemical Thermodynamics.
vi. Chemical Thermodynamics.
vii. Chemical Thermodynamics.

Q.2.A. i) Chemical Thermodynamics. **4 marks**
ii) Chemical Thermodynamics. **3 marks**

OR

Q.2.A iii) Chemical Thermodynamics. **4 marks**
iv) Chemical Thermodynamics. **3 marks**

Q.2.B. i) System of Variable Composites. **4 marks**
ii) System of Variable Composites. **4 marks**

Q.3.A i) Chemical Thermodynamics. **4 marks**
ii)Chemical Thermodynamics. **3 marks**

OR

Q.3.A iii) Chemical Thermodynamics. **4 marks**
iv) Chemical Thermodynamics. **3 marks**

Q.3.B. i) Chemical Equilibrium **4 marks**
ii) Chemical Equilibrium **4 marks**

Q.4.A i) Chemical Thermodynamics. **4 marks**
ii) Chemical Thermodynamics. **3 marks**

OR

Q.4.A. iii) Chemical Thermodynamics. **4 marks**
iv) Chemical Thermodynamics. **3 marks**

Q.4.B. i) Solution and Colligative properties. **4 marks**
ii) Solution and Colligative properties. **4 marks**

Q.5.A. i) Chemical Thermodynamics. **4 marks**
ii) Chemical Thermodynamics. **3 marks**

OR

Q.5.A. iii) Solution and Colligative properties. **4 marks**
iv) Chemical Thermodynamics. **3 marks**

Q.5.B. i) Chemical Equilibrium **4 marks**
ii) System of Variable Composites **4 marks**

Note: Examiners may give sub-questions depending upon weightage of marks and proportionate answer expected.

Semester -II
B.Sc. HONOURS WITH CHEMISTRY
Inorganic Chemistry-II
Core Course: (DSC 5)

Time Duration: 2 Hours **Total Marks: 80**

Q.1. Answer **any five** from the following: **(4 x 5 = 20 Marks)**

i. Chemistry of s and p Block Elements
ii. Chemistry of s and p Block Elements
iii. Chemistry of s and p Block Elements
iv. Acids and Bases
v. Acids and Bases
vi. Noble gases
vii. Inorganic Polymers

Q.2. A. Answer the following:

i) Acids and Bases **4 Marks**

ii) Noble gases **3 Marks**

OR

Q.2. A. Answer the following:

iii) Chemistry of s and p Block Elements **4 Marks**

iv) Noble gases **3 Marks**

Q.2. B. Answer the following:

i) Chemistry of s and p Block Elements **4 Marks**

ii) Acids and Bases **4 Marks**

Q.3. A. Answer the following:

i) Acids and Bases **4 Marks**

ii) Chemistry of s and p Block Elements **3 Marks**

OR

Q.3. A. Answer the following:

iii) Chemistry of s and p Block Elements **4 Marks**

iv) Noble gases **3 Marks**

Q.3. B. Answer the following:

i) Chemistry of s and p Block Elements **4 Marks**

ii) Inorganic polymer **4 Marks**

Q.4. A. Answer the following:

i) Chemistry of s and p Block Elements **4 Marks**

ii) Noble gases **3 Marks**

OR

Q.4. A. Answer the following:

iii) Chemistry of s and p Block Elements **4 Marks**

iv) Noble gases **3 Marks**

Q.4. B. Answer the following:

i) Chemistry of s and p Block Elements **4 Marks**

ii) Inorganic Polymers **4 Marks**

Q.5. A. Answer the following:

i) Chemistry of s and p Block Elements **4 Marks**

ii) Noble gases **3 Marks**

OR

Q.5. A. Answer the following:

iii) Chemistry of s and p Block Elements **4 Marks**

iv) Inorganic Polymers **3 Marks**

Q.5. B. Answer the following:

i) Chemistry of s and p Block Elements **4 Marks**

ii) Inorganic Polymers **4 Marks**

Note: Examiners may give sub-questions depending upon weightage of marks and proportionate answer expected.

Semester -II
B.Sc. HONOURS WITH CHEMISTRY
Organic Chemistry-II
Core Course: (DSC 6)

Time Duration: 2 Hours **Total Marks: 80**

Q1) Answer **any five** questions of the following. **(4 x 5 = 20 marks)**

i. Chemistry of halogenated hydrocarbons
ii. Alcohols, Phenols, ethers and epoxides
iii. Carbonyl compounds
iv. Carboxylic acids and derivatives
v. Chemistry of halogenated hydrocarbons
vi. Alcohols, Phenols, ethers and epoxides
vii. Organosulphur Compounds

Q.2.A. i) Chemistry of halogenated hydrocarbons **4 marks**
ii) Alcohols, Phenols, ethers and epoxides **3 marks**

OR

Q.2.A. iii) Chemistry of halogenated hydrocarbons **4 marks**
iv) Alcohols, Phenols, ethers and epoxides **3 marks**

Q.2.B. i) Carbonyl compounds **4 marks**
ii) Organosulphur compounds **4 marks**

Q.3.A. i) Carbonyl compounds **4 marks**
ii) Alcohols, Phenols, ethers and epoxides **3 marks**

OR

Q.3.A. iii) Carbonyl compounds **4 marks**
iv) Organosulphur compounds **3 marks**

Q.3.B. i) Chemistry of halogenated hydrocarbons **4 marks**

ii) Carboxylic acid s and derivatives **4 marks**

Q.4.A. i) Carboxylic acids and derivatives **4 marks**

ii) Carbonyl compounds **3 marks**

OR

Q.4.A. iii) Carboxylic acids and derivatives **4 marks**

iv) Carbonyl compounds **3 marks**

Q.4.B. i) Chemistry of halogenated hydrocarbons **4 marks**

ii) Alcohols, Phenols, ethers and epoxides **4 marks**

Q.5.A. i) Alcohols, Phenols, ethers and epoxides **4 marks**

ii) Carbonyl compounds **3 marks**

OR

Q.5.A. iii) Chemistry of halogenated hydrocarbons **4 marks**

iv) Carboxylic acids and derivatives **3 marks**

Q.5.B. i) Chemistry of halogenated hydrocarbons **4 marks**

ii) Alcohols, Phenols, ethers and epoxides **4 marks**

Note: Examiners may give sub-questions depending upon weightage of marks and proportionate answer expected.

PAPER PATTERN FOR GENERIC ELECTIVE (GE) PAPERS OF B.Sc. HONOURS WITH CHEMISTRY PROGRAMME
SEMESTER I
GENERIC ELECTIVE PAPER (GE) (Minor-Chemistry)
(ONLY THEORY COMPONENT)
(4 credits: Theory-04)
Inorganic Chemistry & Organic Chemistry (GE-1)

Time Duration: 2 Hours **Total Marks: 80**

Section A: Inorganic Chemistry-1 Marks: 40

Q.1. Answer **any five** from the following: **(2 x 5 = 10 Marks)**

i. Atomic structure

ii. Atomic structure

iii . Atomic structure

iv. Chemical bonding and Molecular structure

v. Chemical bonding and Molecular structure

vi. Chemical bonding and Molecular structure

vii. Chemical bonding and Molecular structure

Q.2. A. Answer the following:

i) Chemical bonding and Molecular structure **4 Marks**

ii) Atomic structure **3 Marks**

OR

Q.2. A. iii) Chemical bonding and Molecular structure **4 Marks**

iv) Atomic structure **3 Marks**

Q.2.B.i) Atomic structure **4 Marks**

ii) Chemical bonding and Molecular structure **4 Marks**

Q.3. A. Answer the following:

i) Chemical bonding and Molecular structure **4 Marks**

ii) Atomic structure **3 Marks**

OR

Q.3. A. iii) Chemical bonding and Molecular structure **4 Marks**

iv) Atomic structure **3 Marks**

Q.3.B i) Atomic structure **4 Marks**

ii) Chemical bonding and Molecular structure **4 Marks**

Section B: Organic Chemistry-1 Marks: 40

Q.4. Answer <u>any five</u> questions of the following . **(2 x 5=10 marks)**

i. Fundamentals of Organic Chemistry
ii. Stereochemistry
iii. Aliphatic hydrocarbons
iv. Fundamentals of Organic Chemistry
v. Aliphatic hydrocarbons
vi. Stereochemistry
vii. Aliphatic hydrocarbons

Q.5.A. i) Fundamentals of Organic Chemistry **4 marks**

ii) Aliphatic hydrocarbons **3 marks**

OR

iii) Fundamentals of Organic Chemistry **4 marks**

iv) Aliphatic hydrocarbons **3 marks**

Q.5.B. i) Stereochemistry **4 marks**

ii) Aliphatic hydrocarbons **4 marks**

Q.6.A. i) Stereochemistry **4 marks**

ii) Aliphatic hydrocarbons **3 marks**

OR

iii) Stereochemistry **4 marks**

iv) Aliphatic hydrocarbons **3 marks**

Q.6.B. i) Stereochemistry **4 marks**

ii) Fundamentals of Organic Chemistry **4 marks**

Note: Examiners may give sub-questions depending upon weightage of marks and proportionate answer expected.

SEMESTER I
GENERIC ELECTIVE PAPER (GE) (Minor-Chemistry)
(THEORY AND PRACTICAL COMPONENTS)
(4 credits: Theory-03, Practical-01)
Inorganic Chemistry & Organic Chemistry (GE-1)

Time Duration: 2 Hours **Total Marks: 60**

Section A: Inorganic Chemistry-1 Marks: 30

Q.1. Answer **any five** from the following: **(2 x 5 = 10 Marks)**

i. Atomic Structure
ii. Atomic Structure
iii. Atomic Structure
iv. Chemical Bonding and Molecular structure
v. Chemical Bonding and Molecular structure
vi. Chemical Bonding and Molecular structure
vii. Chemical Bonding and Molecular structure

Q.2. A. Answer the following:

i) Chemical Bonding and Molecular structure **3 Marks**

ii) Chemical Bonding and Molecular structure **2 Marks**

OR

Q.2. A. Answer the following:

iii) Chemical Bonding and Molecular structure **3 Marks**

iv) Chemical Bonding and Molecular structure **2 Marks**

Q.2.B. Answer the following:

i) Atomic Structure **3 Marks**

ii) Atomic Structure **2 Marks**

Q.3.A. Answer the following:

i) Atomic Structure **3 Marks**

ii) Atomic Structure **2 Marks**

OR

Q.3.A. Answer the following:

iii) Atomic Structure **3 Marks**

iv) Atomic Structure **2 Marks**

Q.3 B. Answer the following:

i) Chemical Bonding and Molecular structure **3 Marks**

ii) Chemical Bonding and Molecular structure **2 Marks**

Section B: Organic Chemistry-1 Marks: 30

Q.4) Answer **any five** questions of the following: **(2x5=10marks)**

i. Fundamentals of Organic Chemistry
ii. Stereochemistry
iii. Aliphatic hydrocarbons
iv. Fundamentals of Organic Chemistry
v. Stereochemistry
vi. Stereochemistry
vii. Aliphatic hydrocarbons

Q.5.A. i) Fundamentals of Organic Chemistry **3 marks**

ii) Stereochemistry **2 marks**

OR

Q.5.A. iii) Fundamentals of Organic Chemistry **3 marks**

iv) Stereochemistry **2 marks**

Q.5.B. i) Stereochemistry **3 marks**

ii) Aliphatic hydrocarbons **2 marks**

Q.6.A. i) Aliphatic hydrocarbons **3 marks**

ii) Stereochemistry **2 marks**

OR

Q.6.A. iii) Aliphatic hydrocarbons **3 marks**

iv) Stereochemistry **2 marks**

Q.6.B. i) Fundamentals of Organic Chemistry **3 marks**

ii) Stereochemistry **2 marks**

SEMESTER II
GENERIC ELECTIVE PAPERS (GE) (Minor-Chemistry)
(ONLY THEORY COMPONENT)
(4 Credits: Theory-04)
Physical Chemistry & Organic Chemistry (GE-2)

Duration: 2 Hours **Total Marks: 80**

Section A: Physical Chemistry-1 Marks: 40

Q.1.Answer **any five** of the following**:** **(2x5=10 marks)**

i. Chemical Energetics.
ii. Chemical Equilibrium.
iii. Ionic Equilibria.
iv. Chemical Energetics.
v. Chemical Equilibrium.
vi. Ionic Equlibria.
vii. Ionic Equilibria

Q.2.A. i) Ionic Equilibria. **4 marks**

ii) Ionic Equlibria. **3 marks**

OR

Q.2.A. iii) Ionic Equilibria. **4 marks**

iv) Ionic Equlibria. **3 marks**

Q.2.B. i) Chemical Equilibrium **4 marks**

ii) Chemical Equilibrium **4 marks**

Q.3.A.i)Chemical Energetics. **4 marks**

ii) Chemical Energetics. **3 marks**

OR

Q.3.A. iii) Chemical Energetics. **4 marks**

iv) Chemical Energetics. **3 marks**

Q.3.B. i) Chemical Equilibrium **4 marks**

ii) Ionic Equilibria **4 marks**

Section B: Organic Chemistry-2 40 Marks

Q.4. Answer any five questions of the following. **(2 x 5 = 10 marks)**

i. Aromatic hydrocarbons
ii. Alkyl and aryl halides
iii. Alcohols, phenols, ethers and carbonyl compounds
iv. Alcohols, phenols, ethers and carbonyl compounds
v. Alkyl and aryl halides
vi. Alcohols, phenols, ethers and carbonyl compounds
vii. Aromatic hydrocarbons

Q.5.A. i) Aromatic hydrocarbons **4 marks**

ii) Alcohols, phenols, ethers and carbonyl compounds **3 marks**

OR

iii) Aromatic hydrocarbons **4 marks**

iv) Alcohols, phenols, ethers and carbonyl compounds **3 marks**

Q.5.B. i) Alkyl and aryl halides **4 marks**

ii) Alcohols, phenols, ethers and carbonyl compounds **4 marks**

Q.6.A. i) Alkyl and aryl halides **4 marks**

ii) Alcohols, phenols, ethers and carbonyl compounds **3 marks**

OR

iii) Alkyl and aryl halides **4 marks**

iv) Alcohols, phenols ,ethers and carbonyl compounds **3 marks**

Q.6. B. i) Aromatic hydrocarbons **4 marks**

ii) Alcohols, phenols, ethers and carbonyl compounds **4 marks**

Note: Examiners may give sub-questions depending upon weightage of marks and proportionate answer expected.

SEMESTER II
GENERIC ELECTIVE PAPERS (GE) (Minor-Chemistry)
(THEORY AND PRACTICAL COMPONENT)
(4 Credits: Theory-03, Practical-01)
Physical Chemistry & Organic Chemistry (GE-2)

Time Duration: 2 Hours **Total Marks: 60**

Section A: Physical Chemistry-1 Marks: 30

Q1.Answer any five of the following: **(2 x 5=10 Marks)**

i. Chemical Energetics.
ii. Ionic Equilibria.
iii. Chemical Energetics.
iv. Chemical Energetics
v. Ionic Equlibria.
vi. Ionic Equilibria
vii. Chemical Energetics

Q.2.A. i) Ionic Equilibria. **3 marks**
ii) Ionic Equlibria **2 marks**

OR

Q.2.A. iii) Ionic Equilibria. **3 marks**
iv) Ionic Equilibria **2 marks**

Q.2.B. i) Chemical Energetics **3 marks**
ii) Chemical Energetics **2 marks**

Q.3.A. i) Chemical Energetics. **3 marks**
ii) Chemical Energetics. **2 marks**

OR

Q.3.A. iii) Chemical Energetics. **3 marks**
iv) Chemical Energetics **2 marks**

Q.3.B. i) Ionic Equilibria **3 marks**

ii) Ionic Equilibria **2 marks**

Section B: Organic Chemistry-2 Marks: 30

Q.4. Answer **any five** questions of the following. **(2 X 5=10 marks)**

i. Aromatic hydrocarbons
ii. Alkyl and aryl halides
iii. Alcohols, phenols, ethers and carbonyl compounds
iv. Alcohols, phenols, ethers and carbonyl compounds
v. Alkyl and aryl halides
vi. Alcohols, phenols, ethers and carbonyl compounds
vii. Aromatic hydrocarbons

Q.5.A. i) Aromatic hydrocarbons **3 marks**

ii) Alkyl and aryl halides **2marks**

OR

Q.5.A. iii) Aromatic hydrocarbons **3 marks**

iv) Alkyl and aryl halides **2 marks**

Q.5.B. i) Aromatic hydrocarbons **3 marks**

ii) Alcohols, phenols, ethers and carbonyl compounds **2 marks**

Q.6.A. i) Aromatic hydrocarbons **3 marks**

ii) Alkyl and aryl halides **2 marks**

OR

Q.6.A. iii) Alcohols, phenols, ethers and carbonyl compounds **3 marks**

iv) Alkyl and aryl halides **2 marks**

Q.6.B. i) Alcohols, phenols, ethers and carbonyl compounds **3 marks**

ii) Alcohols, phenols, ethers and carbonyl compounds **2 marks**

Laboratory Exercises, Marks distribution and duration of time for Practical Examinations

ANNEXURE -IVa: For Semester-I and Semester- II Core Course **(CC)-LAB** of **B.Sc. WITH CHEMISTRY** Programme. .....1 Paper per Semester.

ANNEXURE- IVb: For Semester-I and Semester-II Core Course **(CC) –LAB** of **B.Sc. HONOURS WITH CHEMISTRY** Programme ...3 Papers per Semester.

ANNEXURE -IVc: For Semester-I and Semester-II Generic Elective **(GE) - LAB** of **B.Sc. HONOURS WITH CHEMISTRY** Programme.... 1 Paper per Semester for **(3+1)** option.

Marking Scheme for Practical Examinations

SEMESTER I

B.Sc. WITH CHEMISTRY

Inorganic Chemistry and Organic Chemistry

Core Course: **DSC-2A** **Total Marks: 50**

Time duration: 6 Hours

Section A: **Inorganic Chemistry**

Time duration: 3 Hours. **Marks: 25**

Experiment: Any 1 experiment from volumetric analysis could be given for examination. **15 marks**

(Reading -10 marks, Systematic work- 3 marks, Calculation – 2 marks,)

Journal **5 marks**

Oral **5 marks**

Section B: **Organic Chemistry**

Time duration: 3 Hours. **Marks: 25**

Experiment: Organic spotting to be given for the examination. **15 marks**

(Preliminary tests- 2 marks, chemical type – 2marks, detection of elements- 2marks, functional group tests- 2marks, m.p./b.p- 2 marks, Systematic work-3 marks, result-2 marks)

Journal **5 marks**

Oral **5 marks**

Note: For Journal marks Examiner(s) shall take into account the regularity of the candidate in attending the Laboratory course, completeness of the exercises, presentation and style of writing the journal.

For Oral examination, Examiner(s) shall assess the knowledge of the candidate in the Course as well as the experiment(s) performed by the candidate.

SEMESTER II

B.Sc. WITH CHEMISTRY

Physical Chemistry and Organic Chemistry

Core Course: **DSC-2B** **Total Marks: 50**

Time duration: 6 Hours

Section A: **Physical Chemistry**

Time duration: 3 Hours. **Marks: 25**

Experiment: Any one Experiment on Thermochemistry/Chemical Kinetics could be given for examination. **15 marks**

(Systematic work-5 marks, Observation: 5 marks, Calculation and graphs: 5 marks)

Journal **5 marks**

Oral **5 marks**

Section B: **Organic Chemistry**

Time duration: 3 Hours. **Marks: 25**

Experiment: Any one Organic preparation to be given for the examination. **15 marks**

(Product quality- 3 marks, percentage yield- 5 marks, m.p. -2 marks, Systematic work-3 marks, result-2 marks)

Journal **5 marks**

Oral **5 marks**

Note: For Journal marks Examiner(s) shall take into account the regularity of the candidate in attending the Laboratory course, completeness of the exercises, presentation and style of writing the journal.

For Oral examination, Examiner(s) shall assess the knowledge of the candidate in the Course as well as the experiment(s) performed by the candidate

Marking Scheme for Practical Examinations

SEMESTER I

B.Sc. HONOURS WITH CHEMISTRY

Inorganic Chemistry

Core Course: **DSC 1-LAB** **Total Marks: 50**

Time Duration: 6 Hours

Experiments: Two experiments to be performed.

Major Experiment - Any one experiment from acid base titration or redox titration could be given for examination. **20 Marks**

(Observation: 14 marks, Systematic Work: 3 marks, Calculation: 3 marks)

Minor Experiment: One Salt containing one cation and one anion to be given **10 Marks**

Journal **10 Marks**

Oral **10 Marks**

Note: For Journal marks Examiner(s) shall take into account the regularity of the candidate in attending the Laboratory course, completeness of the exercises, presentation and style of writing the journal.

For Oral examination, Examiner(s) shall assess the knowledge of the candidate in the Course as well as the experiment(s) performed by the candidate

SEMESTER I

B.Sc. HONOURS WITH CHEMISTRY

Physical Chemistry

Core Course: **DSC 2-LAB** **Total Marks: 50**

Time Duration: 6 Hours

Experiments: Two experiments to be performed

Major experiment: Any one experiment from surface tension or viscosity could be given for examination. **20 Marks**

(Observation: 7 marks, Calculation and Graph: 10 marks, Systematic work-3 marks)

Minor experiment: Any one experiment from pH metric titrations could be given for examination. **10 Marks**

(Observation: 4 marks, Calculation and Graph: 5 marks, Systematic work- 1 marks)

Journal **10 Marks**
Oral **10 Marks**

Note: For Journal marks Examiner(s) shall take into account the regularity of the candidate in attending the Laboratory course, completeness of the exercises, presentation and style of writing the journal.
For Oral examination, Examiner(s) shall assess the knowledge of the candidate in the Course as well as the experiment(s) performed by the candidate

SEMESTER I

B.Sc. HONOURS WITH CHEMISTRY

Organic Chemistry

Core Course: **DSC 3-LAB** **Total Marks: 50**

Time Duration: 6 Hours

Experiments: Two experiments to be performed

Major experiment: One organic spotting to be given for examination. **20 Marks**

(Preliminary test-1 marks, chemical type-3 marks, purification -2 marks, detection of elements-2 marks, functional group tests-3 marks, mp/bp-2 marks, confirmatory test-2 marks, systematic work-3 marks, result -2 marks)

Minor experiment: Any one of the following experiments could be given **10 Marks**

1. Recrystallisation - (Experiment-3 marks, mp.-2 marks, quality and percentage yield-2 marks, systematic work – 2 marks, result – 1 marks)
2. Distillation- (Experiment -3 marks, bp- 2 marks, quality and percentage yield- 2marks, systematic work – 2 marks, result -1 marks)
3. TLC technique- To measure Rf value of an organic compound- (Experiment-3 marks, mobile phase-2 marks, spotting-2 marks, Systematic work -2 marks, result- 1 marks.)

Journal **10 Marks**

Oral **10 Marks**

Note: For Journal marks Examiner(s) shall take into account the regularity of the candidate in attending the Laboratory course, completeness of the exercises, presentation and style of writing the journal.

For Oral examination, Examiner(s) shall assess the knowledge of the candidate in the Course as well as the experiment(s) performed by the candidate

SEMESTER II

B.Sc. HONOURS WITH CHEMISTRY

Physical Chemistry

Core Course: **DSC 4-LAB** **Total Marks: 50**

Time Duration: 6 Hours

Experiments: Two experiments to be performed

Major experiment- Any one experiment from Thermo chemistry **20 Marks**
(Observation : 6 marks, Calculation and Graph:10 marks Systematic work-4 marks)

Minor experiment- Any one experiment from chemical kinetics **10 Marks**

(Observation: 4 marks, Calculation and Graph: 5 marks Systematic work-1 marks)

Journal **10 Marks**

Oral **10 Marks**

Note: For Journal marks Examiner(s) shall take into account the regularity of the candidate in attending the Laboratory course, completeness of the exercises, presentation and style of writing the journal.
For Oral examination, Examiner(s) shall assess the knowledge of the candidate in the Course as well as the experiment(s) performed by the candidate

SEMESTER II

B.Sc. HONOURS WITH CHEMISTRY

Inorganic Chemistry

Core Course: **DSC 5-LAB** **Total Marks: 50**

Time Duration: 6 Hours

Experiments: Two experiments to be performed

Major experiment- Any one experiment from Double Burette titration could be given **20 Marks**

(Observation: 14 marks, Calculation and Graph: 3 marks, Systematic work-3 marks)

Minor experiment- One Salt containing one cation and one anion to be given **10 Marks**

(Preliminary tests: 2 marks, Cation: 4 marks, anion: 3 marks Systematic Work: 1 marks)

Journal **10 Marks**

Oral **10 Marks**

Note: For Journal marks Examiner(s) shall take into account the regularity of the candidate in attending the Laboratory course, completeness of the exercises, presentation and style of writing the journal.

For Oral examination, Examiner(s) shall assess the knowledge of the candidate in the Course as well as the experiment(s) performed by the candidate

SEMESTER II

B.Sc. HONOURS WITH CHEMISTRY

Organic Chemistry

Core Course: **DSC 6-LAB** **Total Marks: 50**

Time Duration: 6 Hours

Experiments: Two experiments to be performed

Major experiment- Any one of the following reactions such as Oxidation, reduction, hydrolysis or condensation reaction could be given for examination **20 Marks**

(Synopsis-mechanism: 2 marks, experiment set-up: 3 marks, Product yield: 5 marks, purification: 3 marks mp/bp: 2 marks, Systematic work: 3 marks, Results: 2 marks)

Minor experiment- Organic derivative preparation to be given **10 Marks**

(Product quality- 3 marks, percentage yield- 3 marks, m.p.-2 marks, Systematic work-1 marks, Results- 1 marks)

Journal **10 Marks**

Oral **10 Marks**

Note: For Journal marks Examiner(s) shall take into account the regularity of the candidate in attending the Laboratory course, completeness of the exercises, presentation and style of writing the journal.

For Oral examination, Examiner(s) shall assess the knowledge of the candidate in the Course as well as the experiment(s) performed by the candidate

Marking Scheme for Practical Examinations

SEMESTER I

B.Sc. HONOURS WITH CHEMISTRY

Generic Elective**: GE-1 LAB**

Inorganic Chemistry & Organic Chemistry

Time Duration: 3 Hours **Total Marks: 25**

Section A: Inorganic Chemistry

Time Duration: 1.5 Hours **Marks: 13**

Experiment: Any 1 experiment from volumetric analysis could be given for examination. **8 Marks**

(Reading -5 marks, Systematic work- 1 marks, Calculation – 2 marks,)

Journal **2 Marks**

Oral **3 Marks**

Section B: Organic Chemistry

Time Duration: 1.5 Hours **Marks: 12**

Experiment: Single compound for Organic analysis to be given for the examination. **7 Marks**

(Preliminary tests- 1 marks, chemical type – 2 marks,

detection of elements- 2 marks, functional group tests- 2 marks)

Journal **3 Marks**

Oral **2 Marks**

Note: For Journal marks Examiner(s) shall take into account the regularity of the candidate in attending the Laboratory course, completeness of the exercises, presentation and style of writing the journal.

For Oral examination, Examiner(s) shall assess the knowledge of the candidate in the Course as well as the experiment(s) performed by the candidate

SEMESTER II

B.Sc. HONOURS WITH CHEMISTRY

Generic Elective**: GE-2 LAB**

Physical Chemistry & Organic Chemistry

Time duration: 3 Hours **Total Marks: 25**

Section A: Physical Chemistry

Time Duration: 1.5 Hours **Marks: 12**

Experiment: Any one of the following experiments could be given **7 Marks**

1. To study solubility of benzoic acid in water
2. Determination of rate constant for hydrolysis of methyl acetate using urea hydrochloride.

(Observation: 3 marks, Calculation & Graphs: 4 marks)

Journal **3 Marks**

Oral **2 Marks**

Section B: Organic Chemistry

Time Duration: 1.5 Hours **Marks: 13**

Experiment: Any one organic preparation to be given for the examination**.** **8 Marks**

(Product quality- 4 marks, recrystallization- 2 marks, m.p-2 marks)

Journal **2 Marks**

Oral **3 Marks**

Note: For Journal marks Examiner(s) shall take into account the regularity of the candidate in attending the Laboratory course, completeness of the exercises, presentation and style of writing the journal.

For Oral examination, Examiner(s) shall assess the knowledge of the candidate in the Course as well as the experiment(s) performed by the candidate