Effective from 2015-2016

B.Sc Program- Core Course Chemistry

I Year-Semester-I- DSC-A

Semester-I

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

UNIT – I Inorganic Chemistry – A 15 Lectures

I.A.1 Periodic Properties

2Lectures Review of trends in atomic and ionic radii- covalent radii-single, double and triple bonds, Vander Waal radii, radii of cations and anions, isoelectronic ions. Ionization energy, electro positivity, basic nature, reducing behavior, electron affinity,electro negativity.

I.A.2 s-Block elements 3 Lectures

General Characteristics of groups I and II elements, Complexation tendencies, Diagonal relationship between Li and Mg, Be and Al.

I.A.3 p-Block elements -I 10 Lectures

Group 13:- synthesis and structure of diborane and higher Boranes (B_4H_{10} &B_5H_9), Boron nitrogen compounds (BN & $B_3N_3H_6$), Lewis acid nature of BX_3.

Group 14: Carbides **–** Classification – ionic, covalent, interstitial – synthesis.Structures and reactivity.Industrial application.Carboranes – Nomenclature, Classification – Closo, Nido and Arachno types.Preparation and application of Graphitic compounds.Silicones – Preparation – a) direct silicon process b) use of Grignard reagent c) aromatic silylation. Classification – straight chain, cyclic and cross- linked. Types oils, greases, resins and rubber – uses.Silicates **–** Classification and structural aspects.

Group 15:- Nitrides **-** Classification – ionic, covalent and interstitial.Structure of boron nitride. Reactivity – hydrolysis.Preparation and reactions of hydrazine, hydroxyl amine, phosphazenes.**Group -16**: Classifications of oxides based on i) chemical behavior and ii) oxygen content.Oxides and Oxy acid of B and C – structure and properties.

Oxy –acids of N, P, S and Cl - structure, acidic nature and redox properties

UNIT – II Organic Chemistry – A 15Lectures

O.A.1 Structural theory and mechanism of organic reactions: 6 Lectures

Brief review of structural theory of organic chemistry, Hybridization.Types of bond fission and organic reagents (Electrophilic, Nucleophilic, and free radical reagents including neutral molecules like H_2O, BF_3, NH_3& $AlCl_3$).

Bond polarization : Factors influencing the polarization of covalent bonds. Electronegativity – inductive effect. Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acids (c) Stability of carbonium ions.

Resonance or Mesomeric effect, application to (a) acidity of phenol. (b) acidity of carboxylic acids. Hyper conjugation and its application to stability of carbonium ions, Free radicals and alkenes.

Types of organic reactions: Addition – electrophilic, nucleophilic and free radical. Substitution – electrophilic, nucleophilic and free radical.Elimination: eliminations (Examples without mechanism).

O.A.2. Acyclic Hydrocarbons :6 Lectures

Alkanes - IUPAC Nomenclature of Hydrocarbons. Methods of preparation: Hydrogenation of alkynes and alkenes, Wurtz reaction, Kolb's electrolysis, Corey- House reaction. Chemical reactivity – inert nature, free radical substitution mechanism.Halogenation example – reactivity, selectivity and orientation.

Alkenes – Preparation of alkenes (a) by dehydration of alcohols (b) Dehydrohalogenation of alkyl halides (c) by dehalogination of 1,2 dihalides (brief mechanism), Zaitsev's rule.

Properties: Addition of Hydrogen – heat of hydrogenation and stability of alkenes. Addition of halogen and its mechanism. Addition of HX, Markonikov's rule, addition of H_2O, HOX, H_2SO_4 with mechanism and addition of HBr in the presence of peroxide (anti - Markonikov's addition). Oxidation – hydroxylation by KMnO4, OSO4, peracids (via epoxidation), hydroboration, ozonolysis – location of double bond.Dienes – Types of dienes, reaction of conjugated dienes – 1,2 and 1,4 addition of HBr to 1, 3 – butadiene and Diel's – Alder reaction.

Alkynes – Preparation by dehydrohalogination of dihalides, dehalogenation of tetrahalides, acetylene from CaC_2.Properties: Acidity of acetylenic hydrogen (Formation of metal acetylides) preparation of higher acetylenes, metal- ammonia reductions. Physical properties, Chemical reactivity – electrophilic addition of X_2, HX, H_2O (tautomerism), Oxidation (formation of enediol, 1,2diones and carboxylic acids), Reduction and polymerization reaction of acetylene.

O.A.3. Alicyclic hydrocarbons (Cycloalkanes) 3Lectures

Nomenclature, Preparation by Freunds methods, heating dicarboxylic metal salts. Properties – reactivity of cyclopropane and cyclobutane by comparing with alkanes. Stability of cycloalkanes – Baeyer's strain theory, Sachse and Mohr predictions and Pitzer's strain theory.Conformational structures of cyclobutane, cyclopentane, cyclohexane.

UNIT – III Physical Chemistry – A15 Lectures

P.A.1 Gaseous state 6Lectures

Deviation of real gases from ideal behavior, Vanderwaal's equation of state. Critical Phenomena: PV- isotherms of real gases, continuity of state, Andrew's isotherms of carbon dioxide. The Vander waals equation and the critical state. Derivation of relationship between critical constants and Vander waal's constants. Experimental determination of corresponding critical constants.The law of corresponding states, reduced equation of state.Joule – Thomson effect and inversion temperature of a gas. Liquifaction of gases: i) Linde'smethod . ii) Claude's method .

P.A.2. Solid state 9Lectures

Laws of Crystallography – (i) Law of Constancy of interfacial angles (ii) Law of Symmetry, Symmetry elements in crystals (iii) Law of rationality of indices. Definition of space lattice, unit cell.Bravais Lattices and seven crystal systems.

X – ray diffraction by crystals: Derivation of Bragg's equation , Determination of structure of NaCl (Bragg's method and Powder method).

Defects in crystals: Stoichiometric and Non – stoichiometric defects.

Valence bond theory of Semiconductors: Extrinsic and Intrinsic semi conductors. n – type and p – type and their application in photo – electro chemical cells

UNIT – IV General Chemistry –A 15 Lectures

G.A.1. Atomic Structure and Elementary Quantum Mechanics 8Lectures

Black Body radiation, Planck's Radiatipon law, Photoelectric effect, heat capacity of Solids, Compton effects.De Broglie's hypothesis, Heisenberg's uncertainty principles, Postulates of quantum mechanics, Schrodinger's wave equation and a particle in a box, energy levels, wave functions and probability densities. Schrodinger's wave equation for H- atom. Separation of variables, Radial wave functions and angular wave functions, probability distribution curves,shapes of s, p and d orbitals. Quantum numbers and their importance.

G.A.2. Theory of quantitative Analysis 7Lectures

Principles of volumetric analysis: Standard solution, indicator, end point, titration error and titration curves.Types of reactions – a) Neutralization – principle, titration curves – strong acid – strong base; strong acid – weak base; weak acid – strong base; weak acid - weak base:, Neutralization indicators b) Redox reactions – principle, titration curves, Redox indicators c) Precipitation reactions – principles, titration curves, Precipitation indicators. d) Complexation – principles, metal ion indicators.

Principles of Gravimetric analysis: Nucleation, precipitation, growth of precipitate, impurities in precipitates – co-precipitation and post precipitation. Filtration, washing, drying and incineration of precipitates.

Practical paper – I (Semester I)DSC A45 hrs (3 hrs/week)

A. Calibrations and Quantitative Analysis I

A.1. Calibration of apparatus:

1. Calibration of weights: Fractional weights
2. Calibration of glassware:Measuring cylinders, Pipettes andBurettes.

A.2 Acid – Base titrations:

1. Estimation of bicarbonate in baking soda
2. Estimation of bicarbonate in washing soda
3. Estimation of carbonate and bicarbonate in a given mixture
4. Alkali content in antacid using HCL
5. Acetic acid content in commercial vinegar using NaOH
6. Estimation of ammonium ion.

A.3 Redox titrations

1. Permanganometry -Estimation of ferrous ion
2. Estimation of calcium ion in chalk as calcium oxalate
3. Dichrometry – Estimation of (i) ferrous and (ii) ferric ions
4. Iodometry –Estimation of copper ion.

I Year Semester-II- DSC- B

Semester-II
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

UNIT – I Inorganic Chemistry – B 15 Lectures

I.B.1Group -174Lectures

Interhalogens – Classification, general preparation, structure of AB, AB_3, AB_5, AB_7 type and their reactivity.Basic iodine – Basic nature and evidence of +I and +III iodine.Polyhalides - Definition and structures of ICI_2^{-1}, ICI_4^{-1} and I_3^-.Comparison of pseudo halogens with halogens.Halides- Classification and structural aspects of Halides of C, Si, N, P and S,

I.B.2 Chemistry of Zero group elements 2Lectures

General preparation, structure, bonding and reactivity of Xenon compounds – Oxides, Halides and Oxy-halides.Clatherate compounds and Anomalous behavior of He (II).

I.B.3Types of inorganic compounds and nomenclature 2Lectures

Classification of inorganic compounds and their nomenclature.

1.B.4Chemistry of d – Block elements 7Lectures

Characteristics of d-block elements with special reference to electronic configuration, variable valence, magnetic properties, catalytic properties and ability to form complexes.Color – d-d transition, color and spectral behavior of transition metal ions with respect to d^1- d^9 configuration.Frost and Latimer diagrams.

Comparative treatment of second and third transition series with their 3d analogues with respect to oxidation state, magnetic behavior and spectral properties.

Study of Ti, Cr and Cu traids: Titanium triad- electronic configuration, reactivity of +III and +IV states, oxides and halidesChromium triad-reactivity of +III and +VI states. Copper triad-reactivity of +I, +II and +III states.

UNIT – II Organic Chemistry – B 15 Lectures

O.B.1 Benzene and its reactivity 8 Lectures

Molecular formula of Benzene, structure of benzene – open chain structure not possible, proposition of cyclic structure by Kekulae, dynamic equilibrium, evidence based on ozonolysis experiment, concept of resonance, resonance energy. Heat of hydrogenation, heat of combustion of benzene, mention of C-C bond lengths and orbital picture of benzene.

Concept of aromaticity – aromaticity(definition) , Huckle's rule – application to Bezinoid compounds(Benzene, Naphthalene, Anthracene and Phenanthracene) and Non- Benzenoid compounds (Cyclopropenylcation, cyclopentadienyl anion and tropyliumcation).

Reactions – General mechanism of electrophilic substitution, mechanism of nitration and sulfonation.Mechanism of halogenation, Friedel Craft's and acylation.

Orientationof aromatic substitution - Defination of ortho, para, and meta directing groups Ring activating and deactivating groups with examples.(Electronic interpretation of various groups like NO_2 and phenolic).

Orientaion: i. Amino, methoxy and methyl groups ii. Carboxy, nitro, nitrile, carbonyl and sulfonic acid groups. iii. Halogens (Explanation by taking minimum of one example from each type)

O.B.2 Polynuclear aromatic hydrocarbons &Arenes2Lectures

Polynuclear hydrocarbons – Structure of naphthalene and anthracene(Molecular Orbital Diagram and Resonance energy) Reactivity towards electrophilic substitution Nitration and suphonation as examples.

O.B.3Halogen compounds 5 Lectures

Nomenclature and classification of alkyl (into primary, secondary, tertiary), aryl, aralkyl, allyl, vinyl, benzyl).Physical properties, chemical reactivity- reduction, formation of RMgX, Nucleophylic substitution reaction – classification into S_N1 and S_N2. Mechanism of, energy profile diagrams of S_N1 and S_N2 reactions. Stereochemistry of S_N2(Walden Inversion), S_N1 (Racemisation) explanation of both by taking the example of optically active alkyl halide- 2-bromo butane. Structure and reactivity – comparision of allyl, benzyl, alkyl, vinyl and aryl halides toward ease of hydrolysis.

UNIT- III Physical Chemistry – B 15 Lectures

P.B.1 Solutions 6Lectures

Liquid-liquid-ideal solutions, Raoult's law. Ideally dilute solutions, Henry's law. Non-ideal solutions.Vapour pressure-composition and vapour pressure-temperature curves. Azeotropes-HCl-H_2O, ethanol-water system and fractional distillation.Partially miscible liquids-phenol-water, nicotine water systems.Effect of impurity on consulate temperature. Immiscible liquids and steam distillation.

Nernst distribution law.Calculation of the partition coefficient.Applications of distribution law.

P.B.2 Liquid state 2 Lectures

Intermolecular forces, structure of liquids (Qualitative description).Structural difference between solids, liquids and gases.

Liquid crystals, the mesomorphic state: classification of liquid crystals in to Smectic and Nematic, differences between liquid crystal, solid and liquid. Applications of liquid crystals as LCD devices.

P.B.3 Colloids and Surface Chemistry 7 Lectures

Colloids: Definition of colloids, classification of colloids.

Solids in liquids (sols): Preparation and properties – Kinetic, optical and electrical: Stability of colloids, protective action, Hardy- Schultz law, gold number.

Liquids in liquids (emulsions): types of emulsions, preparation and emulsifier. Liquids in solids (gels): classification, preparation and properties, inhibitors, general applications of colloids.

Adsorption: Types of Adsorption, Factors influencing adsorption. Freundlich Adsorption isotherm, Langmuir theoty of uni layer adsorption isotherm.Applications.

UNIT – IV General Chemistry – B15 Lectures

G.B.1 Chemical Bonding 7 Lectures

Ionic solids – lattice and salvation energy, solubility of ionic solids.Fajan's rules.Polarizing power and polarisability of ions.

Covalent bond- Stereochemistry of inorganic molecules – common hybridization and shapes

Molecular orbital theory – Shapes and sign convention of atomic orbital, modes of overlapping, concepts of sigma and pi bonds, criteria for forming molecular orbital from atomic orbital, LCAO – concept, types of molecular orbital – bonding, anti – bonding and non – bonding, electron density distribution diagram for H2+, MOED of homo- nuclear- H_2, He^{2+}, B_2, C_2, N_2, O_2, F_2 and their ions(unhybridised diagrams only) and hetero- nuclear diatomic molecules CO,CN^-, NO, NO^- and HF. Bond order and magnetic properties.

G.B.2Theory of Qualitative Analysis 4Lectures

Semi – micro analysis: Principles involved – solubility product, common ion effect, reactions of anions, Separation of cations into groups; group reagents; reactions of cations; theory of Flame test.

G.B.3 Non – aqueous solvents4Lectures

Classification and characteristics of a solvent.Reactions in liquid ammonia – physical properties, auto-ionisation, examples of ammono acids and ammono bases. Reactions taking place in liquid ammonia – precipitation, neutralization, solvolysis, solvation - solutions of metals in ammonia, complex formation and redox reactions.Reactions in HF – auto-ionisation, reactions taking place in HF – precipitation, acid – base reactions and protonation.

Practical Paper – II (Semester II)DSC B45 hrs(3 hrs/week)

B. Quantitative Analysis II and Inorganic Preparations

B.1 Precipitation titrations:

1. Estimation of Zinc ion by ferrocyanide

B.2Complexometric titrations:

1. Standardisation of EDTA
2. Estimation of Magnesium ion in talcum powder
3. Hardness of water
4. Estimation of Nickel
5. Estimation of Copper

B.3Gravimetry:

1. Estimation of barium sulphate
2. Estimation of Nickel as Nickel dimethyl glyoximate

B.4 Inorganic Preparations:

1. Ammonium chloride
2. Potash alum
3. Tetramminecopper(II) sulphate

Recommended Text Books and Reference Books
Inorganic Chemistry

1. Concise Inorganic Chemistry by J.D.Lee
2. Basic Inorganic Chemistry by Cotton and Wilkinson
3. Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu and Madan
4. A textbook of qualitative inorganic analysis by A.I. Vogel
5. Qualitative Inorganic analysis by A.I.Vogel
6. Inorganic Chemistry by D.F.Shriver, P.W.Atkins and C.H.Langford
7. Theoretical inorganic chemistry by McDay and J.Selbin
8. Chemical bonding and molecular geometry by R.J.Gillepsy and P.L.Popelier

Recommended Text Books and Reference Books
Organic Chemistry

1. Organic Chemistry By R T Morrison and R.N.Boyd
2. Organic Chemistry by T.J.Solomons
3. Organic Chemistry by L.G.WadeSr
4. Organic Chemistry by D.Cram, G.S.Hammond and Herdricks
5. Modern Organic Chemistry by J.D.Roberts and M.C.Caserio
6. Text book of Organic Chemistry by Ferguson
7. Problems and their solutions in organic Chemistry by I.L.Finar
8. Reaction mechanisms in Organic Chemistry by S.M.Mukherji and S.P.Singh
9. A guide book to mechanisms in Organic Chemistry by Peter Sykes
10. Organic spectroscopy by J.R.Dyer
11. Organic Spectroscopy by William Kemp

Recommended Text Books and Reference Books

Physical Chemistry

1. Elements of Physical Chemistry by Peter Atkins, Julio D. Paula
2. Text book of Physical Chemistry by P.L.Soni, O.P.Dharmarha and Q.N.Dash
3. Physical Chemistry, B.D. Khosla, R. Chand Co
4. Physical Chemistry by G K Vemulapaali, Prentice Hall
5. Analytical Chemistry, Scoog.
6. Physical Chemistry through problems, SK Dogra and S Dogra, New Age Publication
7. Solid State Chemistry and its applications by Anthony R. West
8. Text book of physical chemistry by K L Kapoor

II Year -Semester-III - DSC- C

Semester-III
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

UNIT – I Inorganic Chemistry – C 15 Lectures

I.C.1 f – Block elements5Lectures

Chemistry of Lanthanides: Electronic structure, position in periodic table, oxidation state, Atomic and ionic radii, lanthanide contraction – cause and consequences, anomalous behavior of post lanthanides, basicity.Magnetic properties – paramagnetism.Colour and spectra – f-f transition.Occurrence and separation – ion exchange method and solvent extraction.

Chemistry of Actinides: Electronic configuration, oxidation stated, actinide contraction, comparison with lanthanides in terms of magnetic properties, spectral properties and complex formation.

Chemistry of Metals

I.C.2 Theories of bonding in metals: 3Lectures

Valence bond theory, Explanation of metallic properties and its limitations, Free electron theory, thermal and electrical conductivity of metals, limitations, Band theory, formation of bands, explanation of conductors, semiconductors and insulators.

I.C.3 Alloys 3 Lectures

Classification, Substitutional solid solutions, interstitial alloys, intermetallic compounds; Hume-Rothery rules. Preparation of alloys: fusion, electro-deposition, reduction and compression. Uses of ferrous and non-ferrous alloys.

I.C.4General methods involved in extraction of metals:4Lectures

Minerals and ores, ore concentration – electromagnetic separation, gravity separation – wilfley table, hydraulic classifier, leaching, froth flotation, Calcination and roasting. Acid and alkali digestion.

Reduction – of oxides, carbonates, halides, sulphides, sulphates- smelting, flux, auto reduction, alumino – thermic reduction, hydrometallurgy, electrolytic reduction.

Purification of impure metals – liquation, fractional distillation, zone refining, oxidative processes – cupellation, bassemerisation, puddling, poling, thermal decomposition, Amalgamation and Electrolysis.

UNIT – II Organic chemistry – C15 Lectures

O.C.1 Hydroxy compounds 6Lectures

Nomenclature and classification of hydroxy compounds. Preparation: from carbonyl compounds. Aryl carbinols by hydroxy methylation.Phenols – (a) by diazotisation (b) from sulfonic acid (c)

from cumene (d) by hydrolysis of halobenzene.Physical properties – Hydrogen bonding (inter molecular and intramolecular) effect of hydrogen bonding on boiling point and water solubility.
Chemical properties (a) acidic nature of Phenols (b) Formation of alkoxide/phenoxides and their reaction with RX (c) replacement of OH by X using PCl_5, PBr_3, $SOCl_2$ and with $HX/ZnCl_2$. Esterification by (a) acid halides, anhydrides and acids (mechanism) (b) Esters of inorganic acids (c) dehydration of alcohols (in case of phenols not possible). Oxidation of alcohols by CrO_3, $KMnO_4$. Special reactions of Phenols – (a) Bromination , (b) Kolbe- Schmidt reaction (c) RiemerTiemann (d) Azo coupling . Analysis of alcohols by oxidation ($KMnO_4$), Ceric ammonium nitrate, Lucas reagentAnalysis of phenols by action of $FeCl_3$, and by the solubility in NaOH.
Poly hydroxyl compounds - Pinacol-pinacolone rearrangement, Oxidatve cleavage ($Pb(OAc)_4$& HIO_4.

O.C.2 Ethers and epoxides 2 Lectures

Nomenclature, preparation by (a) Williamson's synthesis (b) from alkenes by the action of conc. H_2SO_4.Physical properties – Absence of Hydrogen bonding, insoluble in water, low boiling point.Chemical properties – inert nature, action of conc. H_2SO_4 and HI.Acid and base catalysed ring opening of epoxides- orientative.

O.C.3 Carbonyl compounds 7Lectures

Nomenclature of aliphatic and aromatic carbonyl compounds and isomerism. Synthesis of aldehydes & ketones from acid chloride, by using 1,3-dithianes, nitriles and from carboxylic acids. Special methods of preparing aromatic aldehydes and ketones by (a) Oxidation of arenes (b) Hydrolysis of benzalhalides .
Physical properties – absence of Hydrogen bonding . Keto-enoltautomerism, polarisability of carbonyl groups, reactivity of the carbonyl groups in aldehydes and ketones.
Chemical reactivity – i. Addition of [a] $NaHSO_3$ (b) HCN (c) RMgX (d) NH_3 (e) RNH_2 (f)NH_2OH(g) $PhNHNH_2$ (h) 2,4DNP Schiff bases, Addition of H_2O to form hydrate (unstable), comparison with chloral hydrate (stable), addition of alcohols - hemi acetal and acetal formation, Halogenation using PCl_5 with mechanism. Base catalysed reactions – with particular emphasis on Aldol, Cannizaro reaction, Perkin reaction, Benzoin condensation, haloform reaction, Knoevengeal condensation. Oxidation reactions –$KMnO_4$ oxidation and auto oxidation, reduction – catalytic hydrogenation, Clemmenson's reduction, Wolf- kishner reduction, MPV reduction, reduction with LAH, $NaBH_4$. Analysis – 2,4 –DNP test, Tollen's test, Fehlings test, Scihff'stest, haloform test (with equations).
Introduction to Unsaturated carbonyl compounds.

UNIT – III Physical chemistry – C15 Lectures

P.C.1 Phase Rule6Lectures

Statement and meaning of the terms – Phase, Componentand degrees of freedom, Gibb's Phase rule, phase equilibria of one component system – water system.Phase equilibria of two-

component system – Solid-liquid equilibria, simple eutectic – Pb-Ag system, desilverization of lead.

Solid solutions – compound with congruent melting point - (Mg-Zn) system and incongruent melting point - ($NaCl-H_2O$) system. Freezing mixtures.

P.C.2Dilute Solutions and Colligative properties 9Lectures

Dilute solutions, colligative properties, ideal and non- ideal solutions. Raoult's law, relative lowering of vapor pressure, molecularweight determination.

Osmosis, laws of osmotic pressure, its measurement, determination of molecular weight from osmotic pressure.

Elevation of boiling point and depression of freezing point; Derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental determination of boiling point and depression of freezing point; Derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties;Abnormal molar mass, Van't Hoff factor, degree of dissociation and association of solutes.

UNIT – IV Generalchemistry – C15 Lectures

G.C.1 : Synthetic drugs –I 4 Lectures

Defination,requirements for an ideal drug source; Terminology: Pharmacy, Pharmacology, Pharmacophore, Pharmacodynamics, Pharmacokinetics (ADME, Receptor – brief treatment), Metabolites and antimetabolites;Nomenclature: Chemical name, generic name and trade name with 3 examples. Classification of drugs based on structure and therapeutic action. Chemotherapeutic agents, Pharmacodynamic agents; Natural drugs:Penicillins, isolation and therapeutic uses, structures of different penicillins.

G.C.2: Synthetic drugs – II 6 Lectures

Structure, name and therapeutic uses of the following drugs:

1.Sulpha drug:Sulphanilamide;2. Antipyretic and analgesics: Paracetamol, Aspirin and Analgin; 3. Anti- inflammatory drug: Ibuprofen; 4. Anti-Parkinson's drug : L-Dopa; 5. Anti-emetic drug: Metoclopramide; 6. Muscle relaxant: Mephensin; 7. Bronchodilator :Salbutamol; 8. Anti malarial drug: Cholroquin; 9. Anti hypertensive and angina drug: Nifedipine; 10. Anti-epileptic drug: Phenobarbital; 11. Anti-bacterial: Ciprofloxacin; 12. HIV AIDS drugs: Indinavir, Zidovudine(Retro AZT, ZD)

G.C.3:Pesticides 5 Lectures

Introduction to pesticides – types – Insecticides, Fungicides, Herbicides, Weedicides, Rodenticides plant growth regulators, Pheremones and Hormones. Brief discussion with examples, Structure and uses.

Synthesis and present status of the following:

1. DDT, 2. BHC, 3.Malathion,4.Parathion,5.Endrine, 6.Baygon, 7.2,4-D and 8. Endo-sulphon

Practical Paper – III (Semester III)DSC C45 hrs(3 hrs/week)

C. Qualitative Inorganic Analysis

C.1 Semi – micro analysis

Analysis of mixtures containing two anions (one simple and one interfering) and two cations(of different groups) from the following:

Anions: Carbonate, sulfide, sulphate, chloride, bromide, iodide, acetate, nitrate, oxalate, tartrate, borate, phosphate, arsenate* and chromate*.

Cations: Lead, copper, bismuth, cadmium, tin, antimony, iron, aluminum, zinc, manganese, nickel, cobalt, magnesium, calcium, strontium, barium, potassium and ammonium.

*not to be given for examination.

II Year -Semester-IV - DSC- D

Semester-IV
(Credits: Theory-04, Practicals-02)
Theory : 60 Lectures

UNIT – I Inorganic Chemistry – D 15 Lectures

I.D.1 Evaluation of analytical data 3Lectures

Accuracy and precision, errors – classification of errors. Determinate and indeterminate errors, absolute and relative error,propagation of errors. Significant figures – mathematical operations – addition, substraction, division and multiplication.

I. D.2 Separation techniques 12LecturesSolvent extraction: Principle and process, Batch extraction, continuous extraction and counter current extraction. Application – Determination of Iron (III)

Chromatography: Classification of chromatography methods, principles of differential migration adsorption phenomenon, Nature of adsorbents, solvent systems, Rf values, factors effecting Rf values.

Paper Chromatography: Principles, Rf values, experimental procedures, choice of paper and solvent systems, developments of chromatogram – ascending, descending and radial. Two dimensional chromatography, applications.

Thin layer Chromatography (TLC): Advantages. Principles, factors effecting Rf values. Experimental procedures.Adsorbents and solvents.Preparation of plates.Development of the chromatogram.Detection of the spots.Applications.

Column Chromatography: Principles, experimental procedures, Stationary and mobile Phases, Separation technique. Applications.

Gas Liquid Chromatography (GLC): Principles and Applications

High Performance Liquid Chromatography (HPLC): Principles and Applications.

UNIT – II Organic chemistry – D15 Lectures

O.D.1 Carboxylic acids and derivatives 5 lectures

Nomenclature, classification and methods of preparation: a) Hydrolysis of Nitrites, amides and esters. b) carbonation of grignard reagents.

Special methods of preparation of Aromatic Acids. Oxidation of the side chain.Hydrolysis of benzotrichlorides.Kolbe reaction. Physical properties- hydrogen bonding, dimeric association, acidity – strength of acids with the examples of trimethyl acetic acid and trichloro acetic acid, Relative differences in the acidity of Aromatic and aliphatic acids.

Chemical properties – Reactions involving H, OH and COOH groups -salt formation, anhydride formation, Acid halide formation, Esterification (mechanism) & Amide formation.

Reduction of acid to the corresponding primary alcohol - via ester or acid chloride. Degradation of carboxylic acids by Huns Diecker reaction, Schmidt reaction (Decarboxylation). Arndt – Eistert synthesis, Halogenation by Hell – Volhard - Zelensky reaction.

Carboxylic acid Derivatives – Reactions of acid halides, Acid anhydrides, acid amides and ester. (mechanism of ester hydrolysis by base and acid).

O.D.2 Synthesis based on Carbanions2Lectures

Acidity of α-Hydrogens, structure of carbanion. Preparation of Acetoacetic ester by Claisen condensation and synthetic application of Aceto acetic ester. [a) Acid hydrolysis and ketonic hydrolysis. Preparation of i] monocarboxylic acids ii) dicarboxylic acids (b) malonic ester – synthetic applications. Preparation of i] substituted mono carboxylic acids ii) substituted dicarboxylic acids. iii) trialkyl acetic acid.

O.D.3Nitrogen compounds8Lectures

Nitro hydrocarbons: Nomenclature and classification – nitro hydrocarbons – structure. Tautomerism of nitroalkanes leading to aci and keto form.Preparation of Nitroalkanes. Reactivity – halogenation, reaction with HONO (Nitrous acid), Nef reaction and Mannich reaction leading to Michael addition and reduction.

Amines (Aliphatic and Aromatic): Nomenclature, Classification into 1°, 2°, 3°Amines and Quarternary ammonium compounds. Preparative methods -1.Ammonolysis of alkyl halides 2.Gabriel synthesis 3.Hoffman's bromamide reaction (mechanism). 4. Reduction of Amides and Schmidt reaction. Physical properties and basic character – Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amine and aniline – comparative basic strength of aniline, N-methylaniline and N,N-dimethyl aniline (in aqueous and non-aqueous medium), steric effects and substituent effects. Use of amine salts as phase transfer catalysts. Chemical properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation e) Reaction with Nitrous acid of 1°, 2°, 3°(Aliphatic and aromatic amines). Electrophilic substitutions of Aromatic amines – Bromination and Nitration.oxidation of aryl and 3°Amines. Diazotization

Cyanides and isocyanides: Nomenclature (aliphatic and aromatic) structure. Preparation of cyanides from a) Alkyl halides b) from amides c) from aldoximes.Preparation of isocyanides from Alkyl halides and Amines. Properties of cyanides and isocyanides, a) hydrolysis b) addition of Grignard reagent iii) reduction iv) oxidation.

UNIT – III Physical chemistry – D 15 Lectures

P.D.1 Electrochemistry-I12Lectures

Electrical transport – conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of specific and equivalent conductance with dilution.

Migration of ions and Kholrausch's law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsagar's equation for strong electrolytes (elementary treatment only).

Transport number, definition and determination by Hittorf method for attackable electrodes.

Applications of conductivity measurements: Determination of degree of dissociation, determination of K_a of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

Types of reversible electrodes – gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes. Electrode reactions, Nernst equation, cell EMF and single electrode potential, standard Hydrogen electrode – reference electrodes – standard electrode potential, sign conventions, electrochemical series and its significance.

P.D.2 Electrochemistry-II 3 LecturesElectrolytic and Galvanic cells: Reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell and its measurement.Computation of EMF.Calculation of thermodynamic quantities of cell reactions- ΔG, ΔH and K.

UNIT – IV General chemistry – D15 Lectures

G.D.1 Molecular spectroscopy 15Lectures

(i) Electronic spectroscopy:

Interaction of electromagnetic radiation with molecules and types of molecular spectra. Potential energy curves for bonding and antibonding molecular orbitals. Energy levels of molecules (σ,π, n) . Selection rules for electronic spectra. Types of electronic transitions in molecules effect of conjugation. Concept of chromophore.

(ii) Infra red spectroscopy

Energy levels of simple harmonic oscillator, molecular vibration spectrum, selection rules. Determination of force constant.Qualitative relation of force constant to bond energies.Anharmonic motion of real molecules and energy levels.Modes of vibrations in polyatomic molecules.Characteristic absorption bands of various functional groups.Finger print nature of infrared spectrum.

(iii) Raman spectroscopy

Concept of polarizavility, selection rules, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

(iv) Proton magnetic resonance spectroscopy (^{1}H-NMR)

Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, NMR splitting of signals – spin-spin coupling, coupling constants. Applications of NMR with suitable examples – ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate, toluene and acetophenone.

(v)Mass Spectrometry: **5 h**

Basic principles – Molecular ion / parent ion, fragment ions / daughter ions. Theory – formation of parent ions. Representation of mass spectrum. Identification of parent ion, (M+1), (M+2), base peaks (relative abundance 100%) Determination of molecular formula – Mass spectra of ethylbenzene, acetophenone, n-butyl amine and 1- proponal.

(vi) Spectral interpretation

Interpretation of IR, UV-Visible, ^{1}H-NMR and mass spectral data of the following compounds 1. Phenyl acetylene, 2. Acetophenone, 3.Cinnamic Acid, 4.para-nitro aniline.

Practical Paper – IV (Semester IV) DSC D 45 hrs(3 hrs/week)

D.Electro-analytical Techniques

D.1Conductometry

1. Determination of concentration of HClconductometrically using standard NaOH solution.
2. Determination of concentration of acetic acid conductometrically using standard NaOH solution.
3. Determination of dissociation constant (K_a) of acetic acid by conductivity measurements.
4. Determination of solubility and solubility product of $BaSO_4$.

D.2Potentiometry

1. Determination of redox potentials of Fe^{2+}/Fe^{3+}; ferrous ammonium sulphate vs. potassium dichromate.

D.3pHmetry

1. Preparation phosphate buffer solutions
2. pH metric titration of weak acid, acetic acid with strong base NaOH and calculation of dissociation constant.

D.4Colorimetry

1. Verification of Beer-Lambert law for $KMnO_4$,$K_2Cr_2O_7$and determination of concentration of the given solution.
2. Verification of Beer-Lambert law for $CuSO_4$ anddetermination of concentration of the given solution.
3. Composition of complex of Cu^{2+}- EDTA disodium salt

Recommended Text Books and Reference Books

Inorganic Chemistry

1. Concise Inorganic Chemistry by J.D.Lee
2. Basic Inorganic Chemistry by Cotton and Wilkinson
3. Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu and Madan
4. A textbook of qualitative inorganic analysis by A.I. Vogel
5. Qualitative Inorganic analysis by A.I.Vogel

6. Inorganic Chemistry by D.F.Shriver, P.W.Atkins and C.H.Langford
7. Theoretical inorganic chemistry by McDay and J.Selbin
8. Chemical bonding and molecular geometry by R.J.Gillepsy and P.L.Popelier
9. Analytical Chemistry by David Krupadanam
10. Analytical Chemistry, Scoog.
11. Analytical Chemistry, G D Christian
12. Industrial Chemistry by B.K.Sharma
13. SeparationMethods, MN Sastry

Recommended Text Books and Reference Books
Organic Chemistry

1. Organic Chemistry By R T Morrison and R.N.Boyd
2. Organic Chemistry by T.J.Solomons
3. Organic Chemistry by L.G.WadeSr
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19. Text book of Organic Chemistry by K.S.Mukherjee
20. Organic Chemistry by BhupinderMeha&Manju Mehta
21. Organic Chemistry by L.G.WadeJr, Maya Shankar Singh
22. Elementary organic spectroscopy by Y.R. Sharma

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1. Physical chemistry A molecular approach by Donald A. Mcquarrie and John D. Simon.
2. Principles of physical chemistry by Prutton and Marron
3. Physical chemistry by Peter Atkins, Julio D. Paula
4. Elements of Physical Chemistry by Peter Atkins, Julio D. Paula
5. Text book of Physical Chemistry by P.L.Soni, O.P.Dharmarha and Q.N.Dash
6. Chemical Kinetics by K J Laidler
7. An Introduction to Electrochemistry by S Glasston
8. Physical chemistry through problems By S K Dogra
9. Kinetics and mechanism by J W Moore and R G Pearson
10. Physical Chemistry, B.D. Khosla, R. Chand Co
11. Physical Chemistry by G K Vemulapaali, Prentice Hall

Recommended Text Books and Reference Books

General Chemistry

1. Applied Chemistry by JayashreeGhosh
2. Drugs by David Krupadanam
3. Pharmacodynamics by R.C.Srivastava, SubitGhosh
4. Analytical Chemistry by David Krupadanam
5. Analytical Chemistry, Scoog.
6. Analytical Chemistry, G D Christian
7. Drugs by David Krupadanam
8. Industrial Chemistry by B.K.Sharma
9. Industrial Chemistry by Banerji
10. Medicinal Chemistry by Ashutoshkar
11. Medicinal Chemistry by P.Parimoo
12. Pharmacology &Pharmacotherapeutics by R.S Satoshkar&S.D.Bhandenkar
13. Synthetic Drugs by O.D.Tyagi&M.Yadav
14. Organic spectroscopy by J.R.Dyer
15. Organic Spectroscopy by William Kemp
16. Elementary organic spectroscopy by Y.R. Sharma
17. Molecular spectroscopy, Banwell

III YEAR -SEMESTER – V DSC E

Semester-V
(Credits: Theory-03, Practicals-02)
Theory:45 Lectures

UNIT – I Inorganic Chemistry – E **15 Lectures**

I.E.1 Coordination Compounds12Lectures

Introduction – Simple salts, Double salts, Complexcompounds.IUPAC Nomenclature of Coordination complexes.Werner's theory - Postulates and experimental evidences, limitations.

Sidwicks theory – Electronic interpretation, coordination number and calculation of EAN, Limitations.Types of ligands, Coordination geometries of metal ions with C.N. 4 and 6.

Isomerism in coordination complexes: a) Structural isomerism – Ionisation, hydrate, linkage, Coordination,Coordination Position and polymerization isomerism. b) Stereoisomerism – (i) Geometrical isomerism in square plannar and octahedral complexes. (ii) Optical isomerism in tetrahedral and octahedral complexes.

Theories of Metal-Ligand bonding in transition metal complexes-

Valence bond theory (VBT) – postulates, application on C.N. 4 (tetrahedral and square plannar) and C.N. 6 (octahedral) complexes.

Crystal field theory (CFT) - Features of CFT, splitting of d-orbital in Oh, Td, Square plannar complexes, explanation with suitable examples.Weak and strong ligands, spectrochemical series, high spin and low spin complexes. Crystal field stabilization energies (CFSE), its calculation for d^n configurations in octahedral complexes; Factors affecting CFSE.

Spectral and Magnetic properties of transition metal complexes – Electronic absorption spectrum of $[Ti(H_2O_6)]^{3+}$ion.

Types of magnetic behavior (para, dia, ferro and antiferromagnetic): Calculation of magnetic moments using spin only formulae. Determination of magnetic susceptibility- Guoy balance method.

Determination of composition of complex by Job's method and Mole ratio method.

I.E.2Stability of metal complexes: 3Lectures

Thermodynamic stability and kinetic stability of metal complexes;Types of stability constants – step-wise and overall stability constants, and relation between them; factors affecting the stability of metal complexes.

UNIT – II Organic chemistry – E **15 Lectures**

O.E.1 Amino acids and proteins 6Lectures

Introduction: Definition of Amino acids, classification of Amino acids into alpha, beta, and gama amino acids. Natural and essential amino acids – definition and examples, classification of alpha amino acids into acidic, basic and neutral amino acids with examples. Methods of synthesis:

General methods of synthesis of alpha amino acids (specific examples – Glycine, Alanine, valine and leucene) by following methods: a) from halogenated carboxylic acid b) Malonic ester synthesis c) strecker's synthesis.

Physical properties: Optical activity of naturally occurring amino acids: L-configuration, irrespective of sign rotation, Zwitterion structure – salt like character - solubility, melting points, amphoteric character , definition of isoelectric point.

Chemical properties: General reactions due to amino and carboxyl groups – lactams from gamma and delta amino acids by heating peptide bond (amide linkage). Structure and nomenclature of peptides and proteins.

O.E.1Heterocyclic Compounds 9Lectures

Introduction and definition; Simple 5 membered ring Compounds with one hetero atom Ex. Furan, Thiophene and pyrrole. Importance of ring systems – presence in important Natural products like hemoglobin and chlorophyll. Numbering the ring systems as per Greek letters and Numbers, Aromatic character – 6- electron system (Four-electrons from two double bonds and a pair of non bonded electrons from the hetero-atom). Tendency to undergo substitution reactions,

Resonance structures; Indicating electron surplus Carbons and electron deficient hetero atom, Explanation of feebly Acidic Character of pyrrole, electrophilic substitution at 2 or 5 position, Halogenation, Nitration and Sulphonation under mild conditions. Reactivity of Furan as 1,3diene, diels alder reaction (one example). Sulphonation of thiophene (purification of Benzene obtained from coal tar). Preparation of furan, pyrrole and thiophene from 1,4 – dicarbonyl compounds only. Structure of pyridine, Basicity – Aromaticity – comparison with pyrrole – one method of preparation – properties – Reactivity towards Nucleophilicsubstitution reactions – chichibabin reaction.

UNIT – III Physical chemistry – E 15 Lectures

P.E.1 Chemical Kinetics 10 Lectures

Rate of a reaction, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light and catalyst. Concentration dependence of rates, mathematical characteristics of simple chemical reactions – Zero order, first order, second order, pseudo first order, half-life and mean life. Determination of order of a reaction – differential method, method of integration, half-life method, isolation method and initial rate method.Radioactive decay as first order phenomenon.

Experimental methods of chemical kinetics: Conductometric, potentiometric, optical methods and polarimetry and spectrophotometer.

Theories of chemical kinetics: effect of temperature on rate of a reaction, Arrhenius equation, and concept of activation energy. Simple collision theory based on hard sphere model.

P.E.2 Photochemistry **5 Lectures**

Interaction of radiation with matter, difference between thermal and photochemical processes.

Laws of photochemistry: Grothus –Draper law. Stark – Einstein law, Quantum yield, photochemical combinations of hydrogen-chlorine and hydrogen-bromine.

Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), photosensitized reactions – energy transfer processes (simple examples).

Semester-VDSEE1(Elective- I)

Semester-V
(Credits: Theory-03, Practicals-02)
Theory:45 Lectures

UNIT – I Inorganic Chemistry – E1 15 Lectures

I.E1.1 Organometallic Chemistry 5 Lectures
Definition and classification of organometallic compounds;Nomenclature, preparation, properties and applications of alkyls of Li, Mg and Al;Preparation and structure of Metallocenes-ferrocene and bis(benzene)chromium.

I.E1.2BioinorganicChemistry10 Lectures
Essential elements, biological significance of Na, K, Mg, Ca, Fe, Co, Ni, Cu, Zn and chloride (Cl^-);Metalloporphyrins – hemoglobin: structure and function; Chlorophyll: structure and role in photosynthesis;Biological Nitrogen fixation; Na-K Pump; Role of calcium in blood clotting, stabilization of protein structures and structural role (bones).

UNIT – II Organic Chemistry – E1 15 Lectures

O.E1.1: Organic Reaction Mechanism5 Lectures
Addition,SubstitutionandElimination reactionswith General mechanisms.

O.E1.2: Selective organic named reactions and their mechanisms10 Lectures
Favorskii reaction, stork enamine reaction, Michael addition,Mannich Bases, Ene reactions, Barter reaction, Baeyer –Villiger reaction, Chichi Babin reaction.

UNIT – IIIPhysical Chemistry – E1 15 Lectures

P.E1.1: Energy Sources
Conventional energy resources: Chemical fuels, classification, (solids, liquids, gaseous). Solid fuels: coal, analysis of coal , proximate and ultimate analysis and their significance. Liquid fuels: petroleum, refining of petroleum, cracking , reforming. Synthetic petrol- Bergius and Fischer-Tropsch's process, knocking, anti knocking agents, octane number. Diesel fuel: Cetane number.Other liquid fuels: LPG, biodiesel, kerosene, fuel oil, benzol, tar, power alcohol. Gaseous fuels:natural gas, coal gas, producer gas, oil gas, water gas, biogas, Combustion: Calorific value and itsdetermination, bomb calorimeter. HCV and LCV values of fuels, problems.analysis of flue gasby Orsats method. Rocket fuels, solid propellants, liquid propellants, monopropellants,bipropellants.
Non conventional energy resources: Nuclear fuels- nuclear reactor, nuclear fission, nuclearfusion, sources of nuclear fuels, disposal of radioactive wastes, reprocessing of nuclear fuels: solar, hydro, wind, tidal energies. Bio fuels, H_2 as a non polluting fuel.

Semester-VDSEE2 (Elective- II)

Semester-V
(Credits: Theory-03, Practicals-02)
Theory:45 Lectures

GREEN CHEMISTRY

E2.1 Introduction to Green Chemistry 15 Lectures

Definition; Need for Green Chemistry; Goals of Green Chemistry;Limitations/ Obstacles in the pursuit of the goals of Green Chemistry;Principles of Green Chemistry: Twelve principles of Green Chemistry.

Principles of Green Chemistryand Designing a Chemical synthesis I (with examples):

Designing aGreen Synthesis using these principles; Prevention of Waste/ byproducts; maximumincorporation of the materials used in the process into the final products (AtomEconomy); prevention/ minimization of hazardous/ toxic products; designing saferchemicals – different basic approaches to do so; selection of appropriate auxiliarysubstances (solvents, separation agents), green solvents, solvent less processes,immobilized solvents and ionic liquids.

E2.2 Principles of Green Chemistryand Designing a Chemical synthesis II (with examples): 15Lectures

Energy requirements for reactions - use ofmicrowaves, ultrasonic energy; selection of starting materials; avoidance of unnecessaryderivatization – careful use of blocking/protecting groups; use of catalytic reagents(wherever possible) in preference to stoichiometric reagents; designing of biodegradableproducts; prevention of chemical accidents, strengthening/ development of analyticaltechniques to prevent and minimize the generation of hazardous substances in chemicalprocesses.

Microwave assisted reactions in water: Hofmann Elimination, Hydrolysis (of benzyl chloride, benzamide.

Microwave assisted reactions in organic solvents: Esterification, Fries rearrangement,OrthoesterClaisen Rearrangement, Diels-Alder Reaction.

Microwave assisted solid state reactions: Deacetylation, Deprotection. Saponification ofesters, Alkylation of reactive methylene compounds, reductions, synthesis of nitriles fromaldehydes.

Ultrasound assisted reactions: Esterification, saponification, substitution reactions, Alkylations, oxidation, reduction, coupling reaction, Cannizaro reaction, Strecker Synthesis.

E2.3 Green Synthesis/ Reactionsand Future Trends in Green Chemistry15 Lectures

Green Synthesis of the following compounds:adipic acid, catechol, benzyl bromide,acetaldehyde, disodium iminodiacetate (alternative to Strecker synthesis), ibuprofen, paracetamol, furfural.

Selective methylation of active methylene group using dimethylcarbonate: Solid-statepolymerization of amorphous polymers using diphenylcarbonate; Use of "Clayan", anonmetallic oxidative reagent for various reactions; Free Radical Bromination; Role of Tellurium in organic syntheses; Biocatalysis in organic syntheses.

Future Trends in Green Chemistry

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorialgreen chemistry; Proliferation of solventless reactions; non-covalent derivatization; Greenchemistry in sustainable development.

Reference Books:

1. V.K. Ahluwalia& M.R. Kidwai: New Trends in Green Chemistry,Anamalaya Publishers (2005).
2. P.T. Anastas& J.K. Warner: Oxford Green Chemistry- Theory and Practical,University Press (1998).
3. A.S. Matlack: Introduction to Green Chemistry, Marcel Dekker (2001).
4. M.C. Cann& M.E. Connely: Real-World cases in Green Chemistry, AmericanChemical Society, Washington (2000).
5. M.A. Ryan & M. Tinnesand, Introduction to Green Chemistry, AmericanChemical Society, Washington (2002).

Practical Paper –V (Semester V) DSC E 45 hrs(3 hrs/week) E.
Preparation of Organic compounds and TLC

E.1 Preparation of Organic compounds:

1. Tribromophenol
2. Tribromoaniline
3. Benzilideneaniline
4. Acetylation of aniline, Benzoylation of Aniline and Phenol.
5. Aromatic electrophilic substitution:
6. Nitration: Preparation of nitro benzene and p-nitro acetanilide.
7. Halogenation: Preparation of p-bromo acetanilide
8. Diazotization and coupling*:* Preparation of phenyl azoβ-naphthol.
9. Oxidation: Preparation of benzoic acid from benzyl chloride.
10. Reduction: Preparation of m-nitro aniline from m-dinitro benzene.
11. Esterification: Preparation of methyl p-nitro benzoate from p-nitro benzoic acid.
12. Methylation: Preparation of β- naphthyl methyl ether.
13. Condensation: Preparation of benzilidine aniline and Benzoyl aniline.

E.2 Synthesis of drugs – 1. paracetamol, 2. asprin

E.3 Thin Layer Chromatography:

Determination of R_f Values and identification of organic compounds: Preparation and separation of 2,4-dinitrophenyl hydrazones of acetone and 2-butanone using toluene and light petroleum (40:60).

Practical Paper –VI(Semester V) DSEE 45 hrs (3 hrs/week)

E. Physical Chemistry Experiments

E.1. Chemical Kinetics:

1. Determination of specific reaction rate of the hydrolysis of methyl/ethyl acetate catalyzed by hydrogen ion at room temperature.
2. Determination of rate of decomposition of hydrogen peroxide.
3. Determination of order of saponification of ethyl acetate.

E.2. Distribution:

1. Determination of distribution coefficient of iodine between water and carbon tetra chloride.
2. Determination of molecular status and partition coefficient of benzoic acid in Toluene and water.

E.3. Determination of Physical Constants

1. Determination of Density using Pyknometer
2. Determination of Viscosity using Viscometer
3. Determination of Surface tension using Stalgnometer
4. Determination of Refractive index using Abbe refractometer
5. Calculation of Parachor&Refrachor.

E.4. Adsorption

1. Adsorption of acetic acid on animal charcoal; verification of Freundlich isotherm.

Recommended Text Books and Reference Books
Inorganic Chemistry

1. Concise Inorganic Chemistry by J.D.Lee
2. Basic Inorganic Chemistry by Cotton and Wilkinson
3. Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu and Madan
4. Inorganic Chemistry by J.E.Huheey
5. Inorganic Chemistry by Chopra and Kapoor
6. Coordination Chemistry by Basalo and Johnson
7. Analytical Chemistry, Gary D Christian
8. Instrumental Methods of Analysis, Skoog

Recommended Text Books and Reference Books
Organic Chemistry

1. Organic Chemistry By R T Morrison and R.N.Boyd
2. Organic Chemistry by T.J.Solomons
3. Organic Chemistry by L.G.WadeSr
4. Organic Chemistry by D.Cram, G.S.Hammond and Herdricks
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22. Elementary organic spectroscopy by Y.R. Sharma
23. Laboratory Manual of Organic Chemistry by Raj K Bansal

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3. Physical chemistry by Peter Atkins, Julio D. Paula
4. Text book of Physical Chemistry by P.L.Soni, O.P.Dharmarha and Q.N.Dash
5. Chemical Kinetics by K J Laidler
6. Physical chemistry through problems By S K Dogra
7. Kinetics and mechanism by J W Moore and R G Pearson

8. Fundamentals of photochemistry by K KRohtagiMukharjee
9. Physical Chemistry, B.D. Khosla, R. Chand Co
10. Physical Chemistry by G K Vemulapaali, Prentice Hall
11. Analytical Chemistry, Scoog.
12. Physical Chemistry through problems, SK Dogra and S Dogra, New Age Publication
13. Text book of Engineering Chemistry by CP Murthy, CV Agarwal, A Naidu
14. Green Chemistry – V.K.Ahluwalia
15. Organic Synthesis by V.K.Ahluwalia and R.Agarwal
16. New trends in Green Chemistry –by V.K.Ahluwalia&M.Kidwai
17. Green Chemistry: Theory and practice by P.T.Anastas and J.C.Warner
18. Engineering Chemistry by Jain and Jain

III YEAR -SEMESTER – VI DSC F

Semester-VI
(Credits: Theory-03, Practicals-02)
Theory :45 Lectures

UNIT – I Inorganic Chemistry – F 15 Lectures

I.F.1 Molecular symmetry:6Lectures

Concept of symmetry in chemistry – symmetry operations, symmetry elements; Rotational axis of symmetry and types of rotational axis; Plane of symmetry and types of planes; Improper rotational axis of symmetry; Inversion centre and identity element. The symmetry operations and point groups. Flow chart for the identification of molecular point groups;Determination of point groups: H_2O, H_2O_2, NH_3, $XeOF_4$, and Trans-1,2-dichloroethylene.

I.F.2 Reactivity of metal complexes: **3Lectures**

Labile and inert complexes: Definitions with examples;Ligand substitution reactions – S_N1 and S_N2 reactions;Substitution reactions of square planar complexes – Trans-effect and applications of trans-effect.

I.F.3Hard and soft acids bases (HSAB): 2Lectures

Classification, Pearson's concept of hardness and softness, application of HSAB principles – Stability of compounds / complexes, predicting the feasibility of a reaction.

I.F.4 Spectrophotometry4Lectures

General features of absorption – spectroscopy, Beer-Lambert's law and its limitations, transmittance, Absorbance, and molar absorptivity. Single and double beam spectrophotometers. Application of Beer-Lambert law for quantitative analysis of 1. Chromium in $K_2Cr_2O_7$, 2.Manganese in manganoussulphate, 3. Iron (III) with thiocyanate.

UNIT – IIOrganic Chemistry – F 15 Lectures

O.F.1. Carbohydrates :6 Lectures

Monosaccharides: All discussion to be confined to (+) glucose as an example of aldo hexoses and (-) fructose as example of ketohexoses. Chemical properties and structureal elucidation: Evidences for straight chain pentahydroxy aldehyde structure (Acetylation, reduction to n-hexane, cyanohydrin formation, reduction of Tollen's and Fehling's reagents and oxidation to gluconic and saccharic acid). Number of optically active isomers possible for the structure, configuration of glucose based on D-glyceraldehyde as primary standard (no proof for configuration is required). Evidence for cyclic structure of glucose (some negative aldehydes tests and mutarotation).Cyclic structure of glucose.Decomposition of cyclic structure (Pyranose structure, anomeric Carbon and anomers). Proof for the ring size (methylation, hydrolysis and oxidation reactions). Different ways of writing pyranose structure (Haworth formula and chair

conformationa formula). Structure of fructose: Evidence of 2 – ketohexose structure (formation of penta acetate, formation of cyanohydrin its hydrolysis and reduction by HI to give 2-Carboxy-n-hexane). Same osazone formation from glucose and fructose, Hydrogen bonding in osazones, cyclic structure for fructose (Furanose structure and Haworth formula).

Interconversion of Monosaccharides: Aldopentose to aldo hexose – eg: Arabinose to D-Glucose, D-Mannose (Kiliani - Fischer method). Epimers, Epimerisation – Lobry de bruyn van Ekenstein rearrangement. Aldohexose to Aldopentoseeg: D-glucose to D-arabinose by Ruff'f degradation. Aldohexose (+) (glucose) to ketohexose (-) (Fructose) and Ketohexose (fructose) to aldohexose (Glucose)

O.F.2Stereochemistry of carbon compounds 9 Lectures

Isomerism*:* Definition, classification into constitutional isomerism and stereoisomerism; Constitutional into- chain, functional, positional and metamerism; Stereoisomerism into conformational and configurational isomerism based on energy.

Representation of Wedge, Newman, Fischer and Saw-horse formulae. Conformational isomerism: Definition, conformations of ethane, propane, n-butane. Stability and energy diagram. Conformations of-cyclobutane, cyclopentane and cyclohexane. Stability and energy diagram.Configurational isomerism: Definition -Division into Geometric and Optical isomerism. Geometric isomerism: i) with reference to alkenes - Cohn-Ingould-Prelogs rules, E&Z

Optical isomerism: Definition of: optical isomerism, enantiomers. Wave nature of light, plane polarised light, optical rotation & specific rotation. Criteria for optical activity-Non superimpossbility of mirror images.

Absence of plane of symmetry, center and axis of symmetry and presence of only single fold axis of symmetry (C_n).Definition of chiral center. Classification of chiral molecules in to asymmetric and dissymmetric molecules

Asymmetric molecules eg: Glyceraldehyde, Lactic acid, Alanine (with chiral centre). Disymmetric molecules: i) Examples with chiral center: with similar chiral carbons (Tataric acid). Examples with dissimilar chiral centers.Calculation of number of enantiomers and mesomers.

Assignment of Configuration-D, L &, R, S configuration for asymmetric and disymmetric molecules. Racemic mixture-Racemisation& Resolution techniques.

Unit-III PhysicalChemistry – F 15 Lectures

P.F.1Thermodynamics

The first law of thermodynamics-statement, definition of internal energy and enthalpy.Heat capacities and their relationship.Joule's law-Joule-Thomson coefficient. Calculation of w, q, dU and dH for the expansion of perfect gas under isothermal and adiabatic conditions for reversible processes. State function.

Temperature dependence of enthalpy of formation-Kirchoff's equation.

Second law of thermodynamics.Different Statements of the law.Carnot cycle and its efficiency.Carnot theorem.Thermodynamic scale of temperature. Concept of entropy, entropy as a state function, entropy changes in cyclic, reversible, and irreversible processes and reversible phase change. Calculation of entropy changes with changes in V & T and P&T. Entropy of mixing inert perfect gases. Entropy changes in spontaneous and equilibrium processes.

The Gibbs (G) and Hlmholtz (A) energies. A &G as criteria for thermodynamic equilibrium and spontaneity-advantage over entropy change. Gibbs equations and the Maxwell relations.Variation of G with P, V and T.

Semester-VIDSEF1 (Elective- I)

Semester-VI
(Credits: Theory-03, Practicals-02)
Theory :45 Lectures

UNIT – I Inorganic Chemistry – F1 **15 Lectures**

I.F1.1MetalCarbonylclusters:

Carbon monoxide as a ligand – Molecular orbitals of CO - Donor and Acceptor molecular orbitals of CO; Bonding modes of CO- Terminal and Bridging;Evidence for multiple bonding from Bond lengths and Stretching frequencies; Classification in to Low Nuclearity and High Nuclearity carbonyl clusters; Factors favouring Metal-Metal bonding; 18 Valence electron rule and its application to Low Nuclearity carbonyl clusters; structure, bonding and shapes of metal carbonyls of $[V(CO)_5]^-$, $[Cr(CO)_6$, $Ni(CO)_4$, $Fe(CO)_5$, $Fe_2(CO)_9$,$Mn_2(CO)_{10}$ and $Co_2(CO)_8$;
M_3 and M_4 clusters , structural patterns in $M_3(CO)_{12}$ (M=Fe,Ru,Os) and $M_4(CO)_{12}$(M=Co,Rh,Ir) Clusters- Relative stability of Bridging and Non- bridging structures . Metal carbonyl scrambling in $Fe_2(CO)_4(cp)_2$ – High Nuclearity clusters M_5,M_6,M_7,M_8 and M_{10} Clusters-, Polyhedral skeletal electron pair theory and Total Electron Count theory – Wades rules – Capping rule – Structural patterns in $[Os_6(CO)_{18}]^{2-}$, $[Rh_6(CO)_{16}]$, $[Os_7(CO)_{21}]$, $[Rh_7(CO)_{16}]^{3-}$, $[Os_8(CO)_{22}]^{2-}$, $[Os_{10}C(CO)_{24}]^{2-}$ and $[Ni_6(CO)_{12}]^{2-}$.

UNIT – IIOrganic Chemistry – F1 **15 Lectures**

O.F1.1 Pericyclic reactions

Concerted reactions, Molecular orbitals, symmetry properties HOMO, LUMO, thermal and photochemical pericyclic reactions.Types of pericyclic reactions- electrocyclic, cycloaddition and sigmatropic reactions- one example each.

O.F1.2 Synthetic strategies

Terminology- Disconnection(dix), Symbol, synthon, synthetic equivalent (SE), Functional group interconversion (FGI), linear, convergent and combinatorial synthesis, target molecule (TM). Retrosynthesis of the following molecules:1) Acetophenone 2) cyclohexene 3) phenylethylbromide.

O.F1.3 Asymmetric (Chiral)synthesis

Definitions- Asymmetric synthesis, enantiomeric excess, diastereomeric excess, stereospecific reactions, definition, example, dehalogenation of 1,2- dibromides by I^-, stereoselective reaction, definition, example, acid catalysed dehydration of 1- phenylpropanol.

UNIT – III Physical Chemistry F115 Lectures

P.F1.1 Materials science 6 Lectures

Superconductivity, characteristics of superconductors, Meissner effect, types of superconductors and applications. Nanomaterials- synthetic techniques, bottom-up-sol-gel method, top-down-electro deposition method. Properties and applications of nano-materials. Composites-definition, general characteristics, particle reinforce and fiber reinforce composites and their applications.

P.F1.2 Catalysis 9 Lectures

Homogeneous and heterogeneous catalysis, comparision with examples. Kinetics of specific acid catalyzed reactions, inversion of cane sugar. Kinetics of specific base catalyzed reactions, base catalyzed conversion of acetone to diacetone alcohol. Acid and base catalyzed reactions-hydrolysis of esters, mutarotation of glucose.Catalytic activity at surfaces.Mechanisms of heterogeneous catalysis.Langmuir-Hinshelwood mechanism.

Enzyme catalysis: Classification, characteristics of enzyme catalysis. Kinetics of enzyme catalyzed reactions-MichaelisMenton law, significance of Michaelis constant (K_m) and maximum velocity (V_{max}). Factors affecting enzyme catalysis- effect of temperature, pH, concentration and inhibitor. Catalytic efficiency.Mechanism of oxidation of ethanol by alcohol dehydrogenase.

Semester-VIDSEF2 (Elective- II)

Semester-VI
(Credits: Theory-03, Practicals-02)
Theory :45 Lectures

POLYMER CHEMISTRY

F2.1 Introduction and history of polymeric materials: 15 Lectures

Different schemes of classification of polymers, Polymer nomenclature, Molecular forcesand chemical bonding in polymers, Texture of Polymers.

Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes,Relationships between functionality, extent of reaction and degree of polymerization.Bifunctionalsystems, Poly-functional systems.

Nature and structure of polymers: Structure Property relationships.

F2.2Kinetics of Polymerization:15 lectures

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationicand anionic) and coordination polymerizations, Mechanism and kinetics ofcopolymerization, polymerization techniques.

Determination of molecular weight of polymers

(*Mn, Mw,* etc) by end group analysis,viscometry, light scattering and osmotic pressure methods. Molecular weight distributionand its significance.Polydispersity index.

F2.3 Glass transition temperature and other properties 15 Lectures

Glass transition temperature (Tg) and determination of Tg,

Free volume theory, WLFequation, Factors affecting glass transition temperature (Tg).

Properties of Polymers

(Physical, thermal, Flow & Mechanical Properties).

Brief introduction to preparation, structure, properties and application of the followingpolymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) andrelated polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoropolymers, polyamides and related polymers. Polyurethanes, silicone polymers, polydienes,Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylenesulphidepolypyrrole, polythiophene)].

Reference Books:

1. Seymour's Polymer Chemistry, Marcel Dekker, Inc.
2. G. Odian: Principles of Polymerization, John Wiley.
3. F.W. Billmeyer: Text Book of Polymer Science, John Wiley.
4. P. Ghosh: Polymer Science & Technology, Tata Mcgraw-Hill.
5. R.W. Lenz: Organic Chemistry of Synthetic High Polymers.

Practical Paper –VII (Semester VI) DSC F 45 hrs (3 hrs/week)F. Qualitative organic analysis and Demo Experiments

F.1 Organic Qualitative Analysis:

1. Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.
2. Separation of two component mixtures
   i) Aniline + Naphthalene
   ii) Benzoic acid + Benzophenone
   iii) p-Cresol + Chlorobenzene.

F.2 Demonstration experiments:

1. Steam distillation experiment: separation of ortho and para nitro phenols
2. Microwave assisted Green synthesis, two examples:
   i) Hydrolysis of Benzamide
   ii) Oxidation of Toluene

Practical Paper –VIII (Semester VI) DSE F 45 hrs(3 hrs/week)

F. Chromatography, Analytical and Spectral problems and computational chemistry

F.1 Chromatography

1. Separation of mixture of amino acids by TLC.
2. Separation of mixture of compounds by column chromatography.

F.2 Analytical problems

1. Simplification problems following the rounding off rules for significant figures.
2. Problems based on working of statistical data- Mean, median, standard deviation, variance, etc.

F.3 Spectral problems

Problems based onstructural elucidation of compounds belonging to different functional groups

F.4 Computational Chemistry (Demonstrations)

Structural Drawing s& Calculation of physical properties of organic and inorganic compounds

Recommended Text Books and Reference Books

Inorganic Chemistry

1. Concise coordination chemistry by Gopalan and Ramalingam
2. Satyaprakash's modern inorganic chemistry by R.D.Madan.
3. Coordination Chemistry by Basalo and Johnson
4. Inorganic Chemistry by J.E.Huheey
5. Organometallic Chemistry – An introduction by R.C.Mehrotra and A.Singh
6. Basic Inorganic Chemistry by Cotton and Wilkinson
7. Group theory, Battacharya
8. Group theory and applications, FA Cotton
9. Bioinorganic Chemistry by Bertini, Lippard&Valantine; Viva books
10. Bioinorganic Chemistry by Lippard& Grey
11. Chemical bonding and Molecular Geometry, RJ Gillepsy and PL Popelier
12. Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu and Madan

Recommended Text Books and Reference Books

Organic Chemistry

1. Organic Chemistry By R T Morrison and R.N.Boyd
2. Organic Chemistry by T.J.Solomons
3. Organic Chemistry by L.G.WadeSr
4. Organic Chemistry by D.Cram, G.S.Hammond and Herdricks
5. Modern Organic Chemistry by J.D.Roberts and M.C.Caserio
6. Text book of Organic Chemistry by Ferguson
7. Problems and their solutions in organic Chemistry by I.L.Finar
8. Reaction mechanisms in Organic Chemistry by S.M.Mukherji and S.P.Singh
9. A guide book to mechanisms in Organic Chemistry by Peter Sykes
10. Organic spectroscopy by J.R.Dyer
11. Organic Spectroscopy by William Kemp
12. Fundamentals of organic synthesis and retrosynthetic analysis by Ratna Kumar Kar
13. Comprehensive practical organic qualitative analysis by V.K.Ahluwalia&SumtaDhingra
14. Comprehensive practical organic chemistry: Preparation and quantitative analysis by V.K.Ahluwalia and ReenaAgarwal.
15. Organic Chemistry by Janice Gorzynski
16. Organic Chemistry by Stanley H Pine
17. Fundamentals of Organic Chemistry by John Mc Murray, Eric Simanek
18. Organic Chemistry by Francis A Carey
19. Text book of Organic Chemistry by K.S.Mukherjee
20. Organic Chemistry by BhupinderMeha&Manju Mehta
21. Organic Chemistry by L.G.WadeJr, Maya Shankar Singh
22. Elementary organic spectroscopy by Y.R. Sharma
23. Laboratory Manual of Organic Chemistry by Raj K Bansal

Recommended Text Books and Reference Books

Physical Chemistry

1. Physical chemistry A molecular approach by Donald A. Mcquarrie and John D. Simon.
2. Principles of physical chemistry by Prutton and Marron
3. Physical Chemistry by Ira N Levine
4. Thermodynamics for Chemists by S Glasstone
5. Chemical thermodynamics by R P Rastogi and S SMisra
6. An Introduction to Electrochemistry by S Glasston
7. Physical chemistry through problems By S K Dogra
8. Thermodynamics by J Jayaram and J C Kuriakose
9. Introductory Quantum Chemistry by A K Chandra
10. Fundamentals of photochemistry by K KRohtagiMukharjee
11. Advanced physical chemistry by Gurudeep Raj
12. Physical chemistry by G W castellan
13. Physical chemistry by Silbey, Alberty and Bawendi.
14. Elements of physical chemistry by Glasstone and Lewis
15. Text book of physical chemistry by S Glasstone
16. Fundamentals of Molecular spectroscopy by C.N.Banwell and E.M.McCash
17. Nanochemistry by Geoffrey Ozin and Andre Arsenault
18. Catalysis: Concepts and green applications by GadiRotherberg
19. Polymer Science by Gowriker, Viswanathan and Jayadev Sridhar
20. Introduction polymer Chemistry By G.S.Misra
21. Polymer Chemistry by Bilmayer
22. Kinetics and Mechanism of Chemical Transformations by Rajaram and Kuriacose.
23. Senior practical physical chemistry by Khosla