

GONDWANA UNIVERSITY, GADCHIROLI

B.Sc.-I Semester I (Chemistry)

(Effective from 2017-18)

- 1) There will be two theory papers in every semester which carry 50 marks each and duration of paper is 3 hrs.
- 2) There will be internal assessment of 10 marks per paper per semester.
- 3) There will be practical examination of 4-5 hours duration and carries 30 marks.

So, the total marks allotted to the chemistry subject per semester is 150 marks.

Theory (100 marks) + Internal assessment (10+10 marks) + Practical (30 Marks) = 150 marks (total)

- 4) The internal assessment will be based on Attendance, Home assignment, Unit test, Terminal test and participation in departmental activities.

The following syllabi are prescribed on the basis of six lectures per week and six practical periods per batch per week. Each theory paper consists of four units of twelve lectures per unit.

THEORY PAPER PATTERN FOR VARIOUS SEMESTER

Semester No.	Paper –I	Paper-II	Practical
Semester I	Inorganic Chemistry (USCChT01)	Organic Chemistry (USCChT02)	PRACTICAL(USCChP01)
Semester II	Organic Chemistry (USCChT03)	Physical Chemistry (USCChT04)	PRACTICAL(USCChP02)
Semester III	Inorganic Chemistry (USCChT05)	Physical Chemistry (USCChT06)	PRACTICAL(USCChP03)
Semester IV	Inorganic Chemistry (USCChT07)	Organic Chemistry (USCChT08)	PRACTICAL(USCChP04)
Semester V	DSE I	DSE II	PRACTICAL
Semester V	DSE I	DSE II	PRACTICAL

Question Paper Pattern

Que.-1 (From Unit I) – (A-5 Marks + B-5 Marks) = 10 Marks or (a-2.5 + b-2.5 + c-2.5 + d-2.5) = 10 Marks

Que.-2 (From Unit II) – (A-5 Marks + B-5 Marks) = 10 Marks or (a-2.5 + b-2.5 + c-2.5 + d-2.5) = 10 Marks

Que.-3 (From Unit III) – (A-5 Marks + B-5 Marks) = 10 Marks or (a-2.5 + b-2.5 + c-2.5 + d-2.5) = 10 Marks

Que.-4 (From Unit IV) – (A-5 Marks + B-5 Marks) = 10 Marks or (a-2.5 + b-2.5 + c-2.5 + d-2.5) = 10 Marks

Que.-5 Solve any 10 out of 12 short answer question each carry one mark (3 short question from each unit)

B.Sc. Part I (Semester - I)

USCHT01

Paper – I (Inorganic Chemistry)

Total marks: 50 Total Lectures: 48

Note: Figures to the right hand side indicate number of lectures

UNIT I

- (A) **Atomic Structure** : Review of Bohr's Theory and its Limitations, Idea of de-Broglie matter waves, Heisenberg's uncertainty principle, Schrodinger wave equation, significance of Ψ and Ψ^2 , quantum numbers, radial and angular wave functions and probability distribution curves, atomic orbital, shapes of s, p and d-orbital, Aufbau and Pauli's exclusion principle, Hund's multiplicity rule, electronic configuration of the elements and ions. [6 L]
- (B) **Periodic Properties**: Atomic and ionic radii, ionization energy, electron affinity and electronegativity - definition, trends in periodic table and applications in predicting and explaining the chemical behavior, factors affecting ionization potential. Pauling's and Mulliken's scales of electronegativity, effective nuclear charge and Slater's rules with some exercise. [6 L]

UNIT II

- (A) **Covalent Bond**: Valence bond theory and its limitations, directionality of covalent bond, overlap criteria of bond strength, Bond energy, bond strength, bond order and bond angle. Various types of hybridization and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3 , H_3O^+ , SF_4 , ClF_3 , ICl_4^- and H_2O . [6 L]
- (B) **Molecular Orbital Theory**: LCAO approximation, wave equation for molecular orbitals, difference between bonding and antibonding MOs in terms of energy and electron density distribution curves, order of energy levels in MOs. MO diagrams for homonuclear diatomic molecules of hydrogen, helium and second row of periodic table. Concept of non-bonding MOs in HF molecule, Coulson's MO diagram of CO and NO. [6 L]

UNIT III

(A) s – Block Elements Comparative study of s – block elements with respect to: i) Atomic & ionic radii, ii) Ionisation Energy iii) Electron Affinity iv) Electronegativity v) Reducing property. Diagonal relationship between Li & Mg, Salient features of hydrides, Salvation and Complexation tendencies including their functions in biosystems. [6 L]

(B) p-Block Elements: Comparative study of p – block elements with respect to: i) Atomic & ionic radii, ii) Ionisation Energy iii) Electron Affinity iv) Electronegativity v) Oxidation State. Diagonal relationship between Be & Al, Preparation, properties and structure of hydrides of 5 th group elements. Nature and bonding in phosphorous trioxides (P_2O_3), phosphorous pentaoxide (P_2O_5) and oxyacids of phosphorous.(6L)

UNIT IV

(A)Hydrogen Bonding: Classification and effect of hydrogen bonding on viscosity, solubility, Melting point and boiling point (2L)

(B) Chemistry of Nobel gas: Chemical properties of Nobel gases, Chemistry of xenon, Structure and bonding in xenon fluorides and oxyfluorides. (4L)

(C) Theory Of Volumetric Analysis i) Acid-Base Titration: Types of acid-base titration, theory of acid-base titration a) Ostwald's theory b) Quinonied Theory, choice of suitable indicators for different acid-base titrations. ii) Redox Titration: General principles involved in redox titrations. Theory of redox indicators external and internal iii) Complexometric Titration: Theory of complexometric titration, metallochrome indicator. (6L)

B.Sc. Part I (Semester - I)

USCHT02

Paper – II (Organic Chemistry)

Total marks: 50 Total Lectures: 48

Note: Figures to the right hand side indicate number of lectures

UNIT-I

Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Definition, examples and applications of Inductive Effect, Electromeric Effect, Resonance and Hyper conjugation. Cleavage of Bonds: Homolysis and Heterolysis.(3L)

Structure, shape and reactivity of organic molecules: Hybridization in organic molecules (sp , sp^2 , sp^3), bond length, bond angles, bond energies. Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. (5L)

Types of Reactions : (In brief with suitable example of each), a) Addition, b) Elimination c) Substitution d) Rearrangement reactions. **(2L)**

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. **(2L)**

UNIT-II

Stereochemistry

(A) Basic concept of Isomerism their Type (Structural chain, position, functional group and stereoisomerism) Interconversion of Wedge Formula, Newman, Sawhorse and Fischer representations. **(4L)**

(B) 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), Conformations with respect to ethane, butane and cyclohexane. Racemisation, resolution and its methods, inversion and retention of configuration, Asymmetric synthesis. **(8L)**

UNIT-III

Aliphatic Hydrocarbons:

Alkane: Nomenclature laboratory methods of preparation by Wurtz reaction, Kolbes reaction and decarboxylation of carboxylic acid, Industrial methods of preparations. Physical properties, reactions of alkanes. Combustion, cracking, LPG, CNG, Cetan number, Octane Numbers, Free radical mechanism of halogenations of methane. **(3L)**

Cycloalkanes: Nomenclature, Method of formation (3-6 membered rings), a) Freund's method, b) Dickmann's method. Chemical reactions of cycloalkanes: Oxidation, Aromatization and Chlorination. Baeyer's strain theory, theory of strainless rings. **(2L)**

Alkenes: 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, oxymercuration-demercuration, Hydroboration-oxidation. **(3L)**

Diene: Nomenclature and classification, Method of formation and Chemical reactions 1-2 and 1-4 additions and Diels-Alder reaction of Conjugated dienes **(2L)**

Alkynes: 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 . **(2L)**

UNIT-IV

Aromatic hydrocarbons

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

Reactions: (Case benzene): Mechanism of Electrophilic Aromatic Substitution 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).

Structure and Orbital diagram of benzene, Aromaticity and Huckel's rule **(8L)**

Orientation: Effect of substituent groups. Activating and deactivating groups. Directing influence of following groups in the light of modern electronic theory (-OH, -Cl, -NO₂, -COOH and -CH₃ groups. **(4L)**

B.Sc.Semester - I

Chemistry Practical USCHP01

Total Marks: 30

Inorganic Chemistry

Volumetric Analysis

- 1) Preparation of standard solution by weighing and Preparation of 0.001 M solution from 0.1M solution by dilution.
- 2) Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
- 3) Estimation of Fe (II) by dichromate using internal indicator (n-phenyl Anthranilic acid)
- 4) Determination of commercial vinegar acetic acid in using NaOH
- 5) Estimation of oxalic acid by titrating it with KMnO_4
- 6) Determination of zinc by complexometric titration with EDTA
- 7) Determination of total hardness of water (permanent and temporary) by EDTA
- 8) Estimation of Cu (II) ions iodometrically using $\text{Na}_2\text{S}_2\text{O}_3$.
- 9.) Estimation of water of crystallization in Mohr's salt by titrating with KMnO_4 .

ORGANIC CHEMISTRY

QUALITATIVE ANALYSIS

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing up to two Extra elements).
2. Systematic Qualitative Organic Analysis of Organic Compounds possessing mono functional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.
3. Separation of mixtures by Chromatography: Measure the R_f value in each case (Combination of two compounds to be given)
4. Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.
5. Identify and separate the sugars present in the given mixture by paper chromatography.
6. Differentiation between a reducing and a non reducing sugar.

Distribution of Marks for Practical Examination

Time 4-5 hours (One Day Examination)	Marks 30
Inorganic Chemistry (Exercise)	12
Organic Chemistry (Exercise)	
(Element : 4 M, Functional group: 4 M. & M. Pt./ B. Pt. 4 M)	12
Viva-Voce	03
Record	03
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Total:	30

B.Sc. Part I (Semester - II)
USCHT03
Paper – I (Organic Chemistry)
Total marks: 50 Total Lectures: 48

Note: Figures to the right hand side indicate number of lectures

UNIT I

Alkyl and Aryl Halides

Alkyl Halides (Up to 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. Elimination reaction of alkyl halide with mechanism (E1, E2), Comparison of substitution and elimination reaction. **(6L)**

Aryl Halides Preparation: (Chloro & bromo 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 $\text{NaNH}_2/\text{NH}_3$). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides. **(6L)**

UNIT-II

Alcohols, Phenols and Ethers

Alcohols: Preparation: Preparation of 1°, 2° and 3° 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. **(4L)**

Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement. **(1L)**

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

Reactions: Electrophilic substitution: Nitration, halogenations, Acetylation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben-Hoesch Condensation, Schotten – Baumann Reaction. Fries rearrangement, Claisen Rearrangement. Comparative acidic strength of alcohols and phenols. **(5L)**

Ethers (aliphatic and aromatic): Introduction, synthesis and reactions of diethyl ether, Cleavage of ethers with HI, Relative reactivity of alcohols and ethers. **(2L)**

UNIT-III

Aldehydes and Ketones (Formaldehyde, acetaldehyde, acetone and benzaldehyde)

(A) Nomenclature, Structure and reactivity of the carbonyl group. **(1L)**

(B) Synthesis of aliphatic aldehyde and ketone by oxidation and dehydrogenation of alcohols, from carboxylic acid, acid chloride. Nitriles, Grignard reagent and from alkene. **(2L)**

(C) Synthesis of aromatic aldehyde (Benzaldehyde) by Rosenmund reduction Gatterman Koch reaction Reimer – Tiemann reaction and from nitriles and ketone (Benzophenone) by Friedel Craft's acylation or benzoylation **(3L)**

(D) Reactions – Reaction with HCN, ROH, NaHSO₃, NH₂-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Benzoin, Perkin, Knoevenagel condensations, Wittig reaction, Clemmensen reduction and Wolff Kishner reduction. Meerwein-Ponndorf Verley reduction. **(6L)**

UNIT-IV

CARBOXYLIC ACIDS AND THEIR DERIVATIVES

Carboxylic acid: Nomenclature, structure and bonding, physical properties: acidity of carboxylic acids, effect of substituent's on acidic strength, preparation and reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction, reduction of carboxylic acids decarboxylation mechanism of decarboxylation. Reformatsky Reaction, Perkin condensation. **(4L)**

Dicarboxylic acids: Succinic acid, Phthalic acid. Methods of formation and effect of heat and dehydrating agents. **(2L)**

Carboxylic acid Derivatives: Structure and nomenclature of acid chloride, esters, amides (urea) and acid anhydride. Relative stability of acyl derivatives. Physical properties, Interconversion of acid derivatives by nucleophilic acyl substitution, formation of carboxylic acid derivatives, chemical reaction. Mechanism of esterification and hydrolysis (acidic & basic) **(6L)**

B.Sc. Part I (Semester - II)

USCHT04

Paper – II (Physical Chemistry)

Total marks: 50 Total Lectures: 48

Note: Figures to the right hand side indicate number of lectures

UNIT I

(A) Mathematical Concepts : Logarithmic relations, Linear graphs, calculation of slopes, differentiation of functions like kx , e^x , $\sin x$, $\log x$ etc. maxima and minima, Integration of useful / relevant functions. Permutations and combinations (introductory), Factorials, Concept of units with references to C.G.S. and S.I. units Inter conversion of units. **[5L]**

(B) Ionic Equilibrium

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 of different salts. Buffer solutions, solubility and solubility product of sparingly soluble salts, applications of solubility product. **(7L)**

UNIT II

Review of Thermodynamics

(A) Recapitulation of thermodynamic terms: system, surrounding types of system (closed open & isolated), Thermodynamic, variables, intensive & extensive properties, thermodynamic processes (isothermal, adiabatic, isobaric, cyclic, reversible & irreversible) State function & path functions, properties of state functions (exact differential, cyclic rule), integrating factor, concept of heat & work. **(3L)**

(B) Statements of first law of thermodynamics, definition of internal energy & enthalpy, heat capacity at constant volume & at constant pressure, Joule-Thomson experiment, Joule Thomson coefficient & Inversion temperature, calculations of $W, Q, \Delta E$ & ΔH for expansion of gases for isothermal & adiabatic conditions for reversible process, Carnot's cycle & its efficiency, thermodynamic scale of temperature. **(5L)**

(C) Thermochemistry: Heat of reaction, standard states, relation between heat of reaction at constant volume & at constant pressure, Hess's law of constant heat of summation & its applications, bond dissociation energy & its calculations from thermochemical data, variation of heat of reaction with temperature (Kirchoff's equation). **(4L)**

UNIT III

Gaseous State

(A) Postulates of kinetic theory of gases, derivation of kinetic gas equation, deduction of various gas laws from kinetic gas equation, Qualitative discussion of the Maxwell – Boltzmann distribution of molecular velocities. Effect of temperature on molecular velocities. Different types of molecular velocities (Most probable RMS and average) and expressions for them. Their inter relationships. Mean free path collision diameter and collision number. **(6L)**

(B) Ideal gas and real gases, behavior of real gases, deviations from ideal behaviors, explanation of the terms – Compressibility factors and Boyle temperature. Causes of deviation from ideal behaviors. Van der Waal's equation of state, explanation of state, explanation of behavior of real gases. Critical phenomenon (P-V isotherms of real gases). Continuity of states. The isotherms of Vander Waal's equation, Relationship between critical constants and Van der Waal's constants Reduce equation of state law of corresponding state. **(6L)**

UNIT IV

(A) Properties of Liquid

i) Surface tension : Explanation, methods of determination using stalgmometer. Parachor value and its application

ii) Viscosity, Explanations, coefficient of viscosity, Effect of temperature on Viscosity, relative viscosity, specific and intrinsic viscosity. Method of determination by Ostwald viscometer. **(4L)**

(B) Solid State

Laws of crystallography-

i) Law of constancy of interfacial angles

ii) Law of rationality of indices

iii) Law of symmetry, symmetry of elements in crystals.

Unit cell, space lattice, orientation of lattice plane (Miller indices).

Bravais lattices, crystal systems, X-ray diffraction by crystal, derivation of Bragg's equation. Determination of crystal structure of NaCl, KCl and CsCl Laue's method and powder method. **(8L)**

B.Sc.Semester - II
Chemistry Practical USCHP02
Total Marks: 30

ORGANIC CHEMISTRY

Purification of an impure organic compound by crystallization / Sublimation method and determination of melting point of purified sample. (Five compounds (1) Phthalic acid, 2) Acetanilide, 3) Benzoic acid, 4) Phenylthiourea 5) Naphthalene.

Note: i) Students should report the melting point of sample before and after crystallization / Sublimation.

ii) Solvents like water, water + alcohol, Alcohol can be selected for crystallization.

1. ORGANIC PREPARATION

Mechanism of various reactions involved to be discussed. Recrystallisation, and determination of melting point and calculation of quantitative yields.

- a. Preparation of acetanilide (Acetylation of Aniline)
- b. Preparation of Benzanilide (Benzoylation of Aniline)
- c. Preparation of Iodoform from ethanol or Acetone.
- d. Preparation of m-di-Nitrobenzene (Nitration)
- e. Preparation of tri-Bromoaniline from Aniline (Bromination)
- f. Preparation of Benzoic acid from Benzamide (Hydrolysis)
- g. Preparation of Benzoic acid from Benzaldehyde (oxidation)
- h. Preparation of Semicarbazone from Acetone.
- i. Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone

PHYSICAL CHEMISTRY PRACTICAL

Thermochemistry

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

Ionic equilibria

pH measurements

a) 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.

b) Preparation of buffer solutions:

(i) Sodium acetate-acetic acid

(ii) Ammonium chloride-ammonium hydroxide

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

Liquid State

1. To determine relative coefficient of viscosity of the given liquid by Ostwald viscometer.
2. To determine percentage composition (v/v) of the given mixture of ethyl alcohol and water by viscosity measurement.
3. To determine surface tension of liquid by stalagmometer.
4. To determine parachor value of $-\text{CH}_2$ group by stalagmometer.
5. To compare cleaning power of detergents by stalagmometer.

Distribution of Marks for Practical Examination

Time 4-5 hours (One Day Examination)	Marks 30
Organic Chemistry (Exercise)	12
Physical Chemistry (Exercise).....	12
Viva-Voce	03
Record	03

Total :	30

Reference Books Recommended (Common for Semester – I and Semester – II)

- Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
- Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
- Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
- Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.
- Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
- Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
- Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
- Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
- Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
- Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
- Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
- Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
- Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
- Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
- Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
- Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
- Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
- Principles of Inorganic Chemistry by Puri. Sharma and Kalia – S. Naginchand & Co. Delhi.

- Text book of Inorganic Chemistry by A. K. De. *Wiley East Ltd.*
- Selected Topics in Inorganic Chemistry by Malik, Tuli and Madan – *S. Chand and Co.*
- Modern Inorganic Chemistry by R. C. Agrawal, *Kitab Mahal.*
- Instrumental Methods of analysis by Chatwal and Anand, *Himalaya Publishing House.*
- Concise Inorganic Chemistry by J. D. Lee, *ELBS.*
- Inorganic Chemistry by J. E. Hoheey – *Harper and Row.*
- Fundamental concepts of Inorganic Chemistry by E. S. Gilreath, *McGraw Hill book Co.*
- Modern Inorganic Chemistry by W. L. Jolly, *McGraw Hill Int.*
- Chemistry Facts, Patterns and Principles by Kneen, Rogers and Simpson, *ELBS.*
- Theoretical Principles of Inorganic Chemistry by G.S. Manku, *Tata McGraw Hill.*
- Inorganic complex compounds by Murmann, Chapman and Hall.
- Text book of Inorganic Chemistry by K. N. Upadhyaya, *Vikas Publishing House, Delhi.*
- Advanced Practical Inorganic Chemistry by Gurdeep Raj. *Goel Publishing House, Meerut.*
- Co-Ordination Chemistry by D. Banerjee, *TMH Publication.*
- Text book of Inorganic Chemistry by Marathe, Bhadange, Mopari and Kubade.
- Organic Chemistry by R. T. Morrison and R. T. Boyd, 6th edition, *PHI.*
- Organic Chemistry by Pine, 5th edition.
- Inorganic Chemistry Vol. I, II and III by Mukharjee, Singh and Kapoor – *Wiley Eastern.*
- Organic Chemistry by S. K. Ghosh.
- Reaction Mechanism in Organic Chemistry by S.M. Mukharjee and S.P. Singh.
- Spectroscopy of Organic Compounds by P. S. Kalsi.
- Stereochemistry and Mechanism through solved problems by P.S. Kalsi.
- Organic Chemistry by TWG Solomons, 4th edition, *John Wiley.*
- Hand book of Organic Analysis by H. J. Clarke, Arnold Heinmen.
- Text book of Practical Organic Chemistry by A. I. Vogel.
- Text book of Organic Chemistry by Jamode, Ganar, Makode, Waghmare, Mahaja, Toshinwal.
- Text book of Organic Chemistry by P.S. Kalsi published by *Macmillan India Ltd. 1999 Delhi.*
- Comparative Practical Organic Chemistry (Qualitative Analysis) by V. K. Ahluwalia and Sunita Dhingra, Orient Longman.
- Comprehensive Practical Organic Chemistry (Preparation and Qualitative Analysis) by V.K. Ahluwalia and Renu Agrawal. Orient Longman.
- Physical Chemistry : Walter J. Moore, 5th edn. New Delhi.
- Physical Chemistry : G. M. Barrow, *McGraw Hill, Indian Edn.*
- Principle of Physical Chemistry : Maron and Prutton.

- Principles of Physical Chemistry : Puri and Sharma
- Physical Chemistry : P. W. Atkins, 4th Edn.
- Text book of Physical Chemistry : P. L. Sony O. R. Dhurma.
- Physical Chemistry : Levine
- Practical Physical Chemistry : Palit and De.
- Practical Physical Chemistry : Yadao
- Practical Physical Chemical : Khosla.
- Laboratory Manual of Physical Chemistry : W. J. Popiel
- Chemistry for Degree Student, Dr. R.L. Madan, *S.Chand and Co. New Delhi*.
- F.Y. B.Sc. Inorganic Chemistry : Semester-I by Dr. S.B. Rewatkar, Dr. E.L.Ramteke, Y.P. Thawari & S.M.Sontakke – *Shell Publication, Nagpur*.
- F.Y. B.Sc. Organic Chemistry : Semester-I by Y.P.Thawari, Dr. S.B. Rewatkar, S.M.Sontakke, Dr. E.L.Ramteke,– *Shell Publication, Nagpur*.
- F.Y. B.Sc. Organic Chemistry : Semester-II by Y.P.Thawari, S.M.Sontakke, Dr. S.B. Rewatkar, T.D. Kose,– *Shell Publication, Nagpur*.
- F.Y. B.Sc. Physical Chemistry : Semester-II by T.D.Kose, Dr. S.B. Rewatkar, S.M.Sontakke, Y.P.Thawari, – *Shell Publication, Nagpur*.
- F.Y. B.Sc. Practical Chemistry : Semester-I by Dr.S.B. Rewatkar, Dr. E.L.Ramteke, Dr.K.R. Lanjewar, Y.P.Thawari, – *Shell Publication, Nagpur*.
- F.Y. B.Sc. Practical Chemistry : Semester-II by Dr.S.B. Rewatkar, Dr. E.L.Ramteke, Dr.K.R. Lanjewar, Y.P.Thawari, – *Shell Publication, Nagpur. (Proposed)*
- Inorganic Chemistry B. Sc. Part I, Sem-I by Dr. N.E. Kathale, S. V.Madhamshettiwar, Dr. D. B. Patil.
- Physical Chemistry B. Sc. Part I, Sem-II by Dr. N.E. Kathale, S. V. Madhamshettiwar, Dr. D. B. Patil.

Reference Books for Practicals:

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
- 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.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- 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.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R.
- Chand & Co.: New Delhi (2011).

B.Sc. Part II (Semester - III) (CBCS)

USCChT05

Paper – I (Inorganic Chemistry)

Total marks: 50 Total Lectures: 48

Note: Figures to the right hand side indicate number of lectures

UNIT I

(A) Hydrides of boron: Structure and bonding in diborane and borazine, Classification and applications of carbides. **[6 L]**

(B) Basic properties of Iodine, interhalogen compounds : Preparation and structure of ClF , ClF_3 , IF_5 & IF_7 . Polyhalides : Classification and structure of I_3^- , I_5^- , I_7^- and ICl_2^- **[2 L]**

(C) Oxy acids of Sulphur: Preparation and Structure of Caro's and Marshall Acid. **[2 L]**

(D) Study of Silicates: Classification, Preparation, Properties and Structure of tetra sulphur tetranitride, S_4N_4 **[2 L]**

UNIT II

A) Ionic Solids: Ionic structures, radius ratio effect & coordination number, Limitation of radius ratio rule, Lattice energy and Born-Haber cycle. Solvation energy and solubility of ionic solids, polarizing power and polarizability of ions, Fajan's rules. **[6L]**

(B) Metallic Bonding: Free electron theory and properties of metals, valence bond theory and Band theory to explain nature of conductors, insulators & semiconductors (intrinsic and extrinsic). **[3L]**

(C) Acids and Bases: Bronsted Lowry Concept Lux-Flood Solvent system and Lewis concept of acid and bases. **[3L]**

UNIT III

A) Chemistry Of First Transition Series Elements: Properties of the elements of first transition series with reference to their electronic configuration, atomic and ionic radii, ionization potential, Variable oxidation state, Magnetic properties, Colour, Complex formation tendency and Catalytic activity. **[8L]**

B) Chemistry Of Elements Of Second And Third Transition Series: Electronic configuration of 4d and 5d transition series. Comparative treatment with 3d-analogous (Groups Cr-Mo-W, Fe-Ru-Os, Co-Rh-Ir, Ni-Pd-Pt) in respect of oxidation states, magnetic behavior and stereo chemistry. **[4L]**

UNIT IV

A) Chemistry Of Lanthanides: Position in periodic table, electronic configuration, oxidation state, atomic and ionic radii, Lanthanide contraction and its consequences, complex forming tendency. Occurrence and isolation of lanthanides (ion-exchange and solvent extraction methods). **[8L]**

B) Chemistry Of Actinides: Position in periodic table, chemistry of actinides with respect to electron configuration, oxidation states, atomic and ionic radii. **[4L]**

B.Sc. Part II (Semester - III) (CBCS)

USCChT06

Paper – II (Physical Chemistry)

Total marks: 50 Total Lectures: 48

Note: Figures to the right hand side indicate number of lectures

UNIT I

Phase Equilibria

(A) Phase rule: statement of phase rule, definition of phase, component and degree of freedom, derivation of phase rule, derivation of Clausius Clapeyron equation & its application in deciding slopes of line for two phase equilibria, applications of phase rule to two phase equilibria of i) water system, ii) sulphur system & iii) Pb-Ag system.

[6L]

(B) Liquid-Liquid mixtures: Ideal liquid mixtures, Raoult's law of ideal solutions, Henry's law, non-ideal systems, azeotropes: HCl -H₂O & ethanol-water system.

Partial miscible liquids: Phenol-water system, trimethylamine-water, nicotine-water system, lower & upper consolute temperature, effect of impurity.

Immiscible liquids: Steam distillation, Nernst distribution law, Limitations, deviations & applications. **[6L]**

UNIT II

Thermodynamics-II

(A) Second law of thermodynamics : Need for second law of thermodynamics, statements of second law of thermodynamics, concept of entropy, entropy as a state function of V & T, P & T, entropy change in phase change for ideal gas, entropy as criteria of spontaneity & equilibrium. **[4L]**

(B) Free energy functions: Helmholtz free energy (A) & Gibbs free energy (G) & their properties, standard free energies, effect of temperature on free energy (Gibbs-Helmholtz equation) & its applications, A & G as criteria for thermodynamic equilibrium. **[4L]**

(C) System of variable composition: partial molar quantities, chemical potential, Van't-Hoff's reaction isotherm, relation between standard free energy change & equilibrium constant (thermodynamic derivation of law of mass action), effect of temperature on equilibrium constant (reaction isochore) **[4L]**

UNIT III

Chemical Kinetics

(A) Concept of reaction rate, factors affecting the rate of a reaction – concentration temperature, pressure, solvent light, catalyst. Derivation of specific rate constant of zero, first and second order reactions and their characteristics. Half life and mean life of reaction with examples. Determination of order of reaction – method of integration, differential method, method of half life period and isolation method. Experimental methods based on conductometry, polarimetry etc. Effect of temperature on rate of reaction, Arrhenius equation concepts of activation energy.

[6L]

(B) Collision theory of bimolecular reactions (hard sphere model). Transition state theory Expression for rate constant based on equilibrium constant and thermodynamic aspects. **[2L]**

(C) Catalysis: Characteristics of catalysed reactions, classification of catalysis with examples (Homogeneous, Gas phase, liquid phase catalysis, Heterogeneous catalytic reaction, enzyme catalysis, Autocatalysis etc.) **[4L]**

UNIT IV

A) Solutions And Colligative Properties :

Methods of expressing concentration of solutions, Raoult's law of relative lowering of vapour pressure, molecular mass determination from relative lowering of vapour pressure. Osmosis, osmotic pressure and its measurement by Barkeley and Hartley method. Determination of molecular mass from osmotic pressure. Elevation of boiling point, determination of molecular mass from elevation of boiling point. Depression of freezing point. Determination of molecular mass from depression of freezing point. Van't Hoff factor, degree of dissociation and association of solute. **[8 L]**

B) Magnetic Properties :

Electron spin angular momentum, spin quantum number, electron as magnetic dipole, magnetic moment of electron, Bohr magneton, relation between magnetic moment and number of unpaired electrons. Magnetic properties of substances. Diamagnetism, paramagnetism, ferromagnetism, determination of magnetic susceptibility using Gouy method. Determination of magnetic moment of paramagnetic substances. Applications of magnetic susceptibility measurements. **[4 L]**

Note: Related numerical should be asked on corresponding topics.

B.Sc. CHEMISTRY PRACTICAL SEM III(CBCS)

USCChP03

(Total Marks:30)

Inorganic Chemistry

Semi micro qualitative analysis of inorganic salt mixture containing two acidic radicals of different group and two basic radicals of same or different groups. At least six mixtures to be given,

Analysis of basic radicals to be done by using spot test reagents.

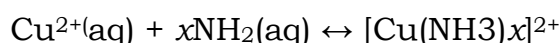
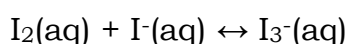
Following radicals to be given

Carbonate, Nitrite, Sulphite, Sulphide, Sulphate, Chloride, bromide, iodide nitrate, silver (I), Mercury (II), lead (II), copper (II), bismuth (III), mercury (I), cadmium (II), tin (II), arsenic (III), antimony (III), iron (III), chromium (III), aluminium (III), nickel (II), cobalt (II), manganese (II), zinc (II), calcium (II), strontium (II), barium (II), magnesium (II), Ammonium ion, Potassium Ion

Physical Chemistry

Distribution

Study of the equilibrium of one of the following reactions by the distribution method:



Phase Equilibria

- Construction of the phase diagram of a ternary system (water-acetic acid-chloroform)
- Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

Chemical Kinetics

Study the kinetics of the following reactions.

1. Kinetics of iodide-persulphate reaction
2. Integrated rate method:
 - a. Acid hydrolysis of methyl acetate with hydrochloric acid.
 - b. Saponification of ethyl acetate.
 - c. Compare the strengths of HCl and H₂SO₄ by studying kinetics of hydrolysis of methyl acetate

Colligative Properties

Determination of molecular weight by Rast Method

Distribution of Marks for Practical Examination

Time 4-5 hours (One Day Examination)	Marks 30
Inorganic Chemistry (Semi micro analysis)	12
Physical Chemistry (Any one Exercise)	12
Viva-Voce	03
Record	03
<hr/>	
Total:	30

Reference Books:

1. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry*, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
4. Mahan, B.H. *University Chemistry*, 3rd Ed. Narosa (1998).
5. Petrucci, R.H. *General Chemistry*, 5th Ed., Macmillan Publishing Co.: New York, (1985).
6. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry* 7th Ed., W. H. Freeman.
7. Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, W.H. Freeman, 2002.
8. 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.
9. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
10. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R.Chand & Co.: New Delhi (2011).
11. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry*, Universities Press.
12. Chemistry for Degree Student, Dr. R. L. Madan, S. Chand and Co. New Delhi.
13. Inorganic Chemistry Vol. I, II and III by Mukharjee, Singh and Kapoor – Willey Eastern.
14. Spectroscopy of Organic Compounds by P. S. Kalsi.
15. Physical Chemistry : Walter J. Moore, 5th edn. New Delhi.
16. Physical Chemistry : G. M. Barrow, McGraw Hill, Indian Edn.
17. Principle of Physical Chemistry : Maron and Prutton.
18. Principles of Physical Chemistry : Puri and Sharma
19. Physical Chemistry : P. W. Atkins, 4th Edn.
20. Text book of Physical Chemistry : P. L. Sony O. R. Dhurma.
21. Physical Chemistry : Levine
22. Practical Physical Chemistry : Palit and De.
23. Practical Physical Chemistry : Yadao
24. Practical Physical Chemical : Khosla.
25. An introduction to synthetic drugs, Himalaya publishing house by Sing and Rangnekar.

B.Sc. Part II (Semester - IV) (CBCS)

USCChT07

Paper – I (Inorganic Chemistry)

Total marks: 50 Total Lectures: 48

Note: Figures to the right hand side indicate number of lectures

UNIT I

A) Coordination Compounds: Distinction among simple salts, double salts and coordination compound, Werner's coordination theory and its experimental verification. Sidwick's electronic interpretation, EAN rule with examples, Nomenclature of coordination compounds. Chelates: classification and their application, Valence bond theory of transition metal complexes. [9L]

B) Isomerism In Coordination Compounds: Structural isomerism and stereoisomerism in coordination compounds. [3L]

Unit-II

A) Hard Acid And Soft Acids And Bases: Classification of acids and bases as hard and soft. Pearson's SHAB Concept and its applications. Acid-base strength of hardness and softness, Symbiosis. Theoretical basis of hardness and softness, electronegativity and hardness and softness. [4L]

B) Oxidation And Reduction: Use of redox potential data: Analysis of redox cycle, redox stability in water:- Frost, Latimer and pourbaix diagram, principle involved in the extraction of the element. [8L]

Unit-III

A) Metal Ligand Bonding In Transition Metal Complexes: Limitations of Valency bond theory, Crystal field theory: Splitting of d-orbital in octahedral, tetrahedral and square planar complexes. Factors affecting the Magnitude of $10Dq$, Crystal field Stabilisation Energy of Octahedral and Tetrahedral complexes (Numericals) [8L]

B) Electronic Spectra Of Transition Metal Complexes : Jahn Teller Effect, Selection Rules (Laporte and Spin selection Rules). Hole Formalism Principle. Electronic spectrum of $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ complex ions [4L]

Unit-IV

A) Thermodynamic And Kinetic Aspect Of Metal Complexes: Thermodynamic and Kinetic stability of metal complexes, their relation. Stepwise stability and overall stability constant and their relationship, Factors affecting the Stability of complexes. Determination of composition of Fe(III)-SSA complex by Mole Ratio and Job's Method. [6L]

B) Colorimetry And Spectrophotometry: Principles of photometry: Beer-Lamberts Law, And its deviation. Types of colorimeter and spectrophotometer with simple schematic diagrams. Application of colorimeter and spectrophotometer in quantitative analysis with reference to estimation of Cu(II) as Cu-ammonia complex. [6L]

B.Sc. Part II (Semester - IV)(CBCS)

USCChT08

Paper – II (Organic Chemistry)

Total marks: 50 Total Lectures: 48

Note: Figures to the right hand side indicate number of lectures

UNIT-I

A. Nitro Compound: Preparation of nitroalkanes and nitroarenes, chemical reactions of nitroalkanes, mechanism of nucleophilic substitution in nitroarenes and their reduction in acidic, neutral and alkaline medium. Preparation and uses of Picric acid. **[3L]**

B. Amino compounds: Structure and nomenclature of amines by Heisenberg's method: Separation of mixture of primary, secondary and tertiary amines. Structural features affecting the basicity of amines. Amine salts as phase transfer catalyst, preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles, reductive amination of aldehydic and ketonic compound and Hoffman-broamamide reaction. Reaction of amine: electrophilic aromatic substitution in aryl amine, reaction of amine with nitrous acid. **[6L]**

C. Diazonium salt: stability & preparation of benzene diazonium chloride, mechanism of diazotization, replacement of diazo group by H, OH, F, Cl, Br, NO₂, CN, groups. Reduction of diazonium salt to hydrazine, coupling reaction and its synthetic applications. **[3L]**

UNIT-II

A. Organometallic Compounds: Synthesis, structure and chemical reaction of organo Mg, Zn & Li compounds.

Method of preparation and chemical reactions of

- i) 1,3 Dithiane Anionon – umpolung
- ii) Sulphur Ylides.
- iii) LDA (Lithium di-isopropyl amide)
- iv) Woodward and Prevost Hydroxylation

[4L]

B. Heterocyclic Compounds : Molecular orbital picture and aromaticity of furan, thiophene, pyrrole and pyridine. Methods of synthesis of pyridine. Mechanism of electrophilic and nucleophilic substitution reaction of pyridine. Chemical reaction of pyridine. Structure of pyridine. Comparison of basicity of pyrrole and pyridine. Introduction to condensed five and six membered heterocycles. Preparation and reactions of Quinoline. Structure of Ferrocein [8L]

UNIT-III

A. Amino Acids, Peptides and Proteins:

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis.

Reactions of Amino acids: ester of -COOH group, acetylation of -NH_2 group, complexation with Cu^{2+} ions, ninhydrin test.

Classification of proteins, Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C activating groups and Merrifield solid-phase synthesis. [9L]

B. Quantitative Analysis: Estimation of C, H, N, S & X (Only principle and calculation, Kjeldahls and Carius method), Calculation of Empirical and molecular formula. [3L]

UNIT-IV

A. Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation. [5L]

B. Synthetic Dyes: Colour and constitution (Witt's theory, electronic concept) Classification of Dyes based on chemical constitution. Synthesis

and uses of methyl orange, Congored, Phenolphthalein, Indigo dye and Alizarin. **[3L]**

C. Drugs :- Definition, qualities of ideal drugs. Basic terminology of drugs (i) Analgesic (ii) Antipyretic (iii) Antibiotics (iv) Tranquilizer (v) Anaesthetic (vi) Antihistaminic (vii) Hormones (viii) Vitamins (ix) Narcotics and Non-Narcotics (Only Definitions). Synthesis and Applications of (i) Aspirin (ii) Paracetamol and their side effects. Uses of Dettol (its Composition), Chloramin-T, Calmpose, Classification of antibiotics with examples. **[4L]**

PRACTICAL SEM IV

USCChP04

Chemistry Practicals

Time 4-5 hrs

Total Marks 30

Inorganic Chemistry

A) Preparation of following complexes: (04 Marks each)

- Potassium trioxalato ferrate Complex (III) $K_3[Fe(C_2O_4)_3].H_2O$
- Copper tetramine complex $[Cu(NH_3)_4] \cdot 2H_2O$
- Nickel-DMG Complex, $[Ni(DMG)_2]$
- Nickel Ammonia Complex, $[Ni(NH_3)_6]Cl_2$
- Potassium trioxalato Aluminium Complex, $K_3[Al(C_2O_4)_3].3H_2O$

B) Colorimetry /spectrophotometry : (08 Marks each)

- Jobs method of determination of composition of Fe- SSA complex
- Mole Ratio Method of determination of composition of Fe- SSA complex

C) Estimate the amount of nickel present in a given solution as bis(dimethylglyoximato)nickel(II) or aluminium as oximate or barium as barium sulphate in a given solution gravimetrically. (12 Marks each)

Organic Chemistry

A) Separation and identification of organic compounds from the given binary mixture.

B) 1. Estimation of the concentration of glycine solution by formylation method.

2. Titration curve of glycine

3. Action of salivary amylase on starch

4. Effect of temperature on the action of salivary amylase on starch.

5. Estimation of glucose.

6. Estimation of amide.

C) 1. Preparation of aspirin.

2. Preparation of paracetamol.

Distribution of Marks for Practical Examination

Time 4-5 hours (One Day Examination)

Marks 30

Inorganic Chemistry : Section A +B OR Section C

12

Organic Chemistry (Section A) OR (Section B + Section C)

12

Viva-Voce

03

Record

03

Total:

30

Reference Books:

1. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
2. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
3. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York,(1985).
4. Cotton, F.A. & Wilkinson, G. *Basic Inorganic Chemistry*, Wiley.
5. Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
6. Wulfsberg, G. *Inorganic Chemistry*, Viva Books Pvt. Ltd.
7. Rodgers, G.E. *Inorganic & Solid State Chemistry*, Cengage Learning India Ltd.,2008.
8. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
9. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
10. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R.Chand & Co.: New Delhi (2011).
11. Advanced Inorganic Chemistry Volume I & II by Satyaprakash, Tuli, Basu
12. Selected Topics in Inorganic Chemistry by Malik, Tuli, Madan.
13. Modern Inorganic Chemistry by Madan.
14. Concise Inorganic Chemistry by J.D. Lee & ELBS.
15. Inorganic Chemistry by J.E. Huheey- Harper & Row
16. Fundamental concepts of Inorganic Chemistry by E.S. Gilreath McGraw Holl book co.
17. Modern Inorganic Chemistry by W.L. Jolly McGraw Holl Int.
18. Chemistry Fact Patterns & Principles by Kneen Rogers and Simpson ELBS.
19. Theoretical Principles of Inorganic Chemistry by G.S. Manku Tata McGraw Holl
20. Organic Chemistry by Morrison and Boyd, Print ice ha 11.
21. Analytical Chemistry-R. Gopalan-Sultan Chand.

22. Physico Chemical Techniques of Analysis – P.B. Janarthanam
Vol – I & II- Asian Publication
23. Instrumental Methods of Chemical Analysis _ B.K. Sharma –
Goel Publication
24. Organic Chemistry by L.G.Wa de. Print ice hall.
25. Organic Chemistry Vol. I, II, III by S.M. Mukharji, S.P. Sing and
R.P. Kapoor
26. Fundamental of Organic Chemistry by Solomon, John willey
27. A Text book of Organic Chemistry by Bahl and Bahl.
28. A Text book of Organic Chemistry by P.L. Soni.
29. A Text book of Organic Chemistry by Tewari Mehrotra.
30. Stereochemistry by P.S. Kalsi.
31. Organic Chemistry by I.L. Finar.
32. A text book of Practical Chemistry for B.Sc. By V.V.Nadkarny,
A.N. Kothare and Y.V. Lawande.
33. A text book of Practical Chemistry for B.Sc. By V.V.Nadkarny,
A.N. Kothare and Y.V. Lawande.
34. Advanced practical inorganic chemistry by O.P. Agarwal.
35. Vogels Text Book of Qualitative Analysis.
36. Synthetic dyes by Gurudeep and Chatwal.
37. Organic chemistry by S.M.Kapoor. vol. II and III
38. Organic chemistry by Morrison and Boyed.
39. Organic chemistry by Arun Bahl and B.S. Bahl.

Discipline Specific Elective Chemistry
(Choose any two)
B.Sc.III (Semester V) (CBCS)
USC DSE ChT 09

Total marks: 50 Total Lectures: 48

Note: Figures to the right hand side indicate number of lectures

Discipline Specific Elective Chemistry I (Organic Chemistry)

UNIT I

Spectroscopy

Nuclear magnetic resonance (NMR) spectroscopy. Proton magnetic resonance (^1H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1, 1, 2, 2-tetrabromoethane, ethyl acetate, toluene and acetophenone. Problems pertaining to the structure elucidation of simple organic compounds using nmr data. (12L)

UNIT II

Organic Synthesis via Enolates.

Definition, Active methylene compounds, Preparation of Acetoacetic ester, (Claisen condensation with Mechanism), Acidity of α hydrogen, properties and reactions involving formation of mono, di and unsaturated carboxylic acids, also synthesis of ketone, diketone, 4-methyl uracil from acetoacetic ester, keto-enol tautomerism. Preparation of diethyl malonate, properties and reactions involved in alkylation, formation of mono, di and unsaturated carboxylic acids, and also synthesis of glycine and barbituric acids from diethyl malonate (12L)

UNIT III

Polymers

Introduction and classification including di-block, tri-block and amphiphilic polymers; (2L)

Polymerization reactions -

Introduction, Hydrolysis, Hydrogenation, Addition and Substitution reactions, Cross-linking

reactions, Cure reactions, Reactions of various aliphatic and aromatic pendent groups in polymers. applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene); (7L)

Fabrics – natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction to liquid crystal polymers; Biodegradable and conducting polymers with examples. (3L)

UNIT IV

Green Chemistry and Technology for sustainable development

Green Chemistry from theory to practice The twelve principles of green chemistry Green Chemistry and sustainable Development Designing Products under the holistic approach “Cardle-to Cardle” Scientific areas for practical applications of green chemistry Use of alternative basic chemicals as feed stocs in chemical industry and research Green Chemistry and Reduction of solvent Toxicity (Alternative Solvents or replacement) Applications of New Methodologies in the synthesis of chemical compounds- catalysis and green chemistry. Green Chemistry and Toxic organic solvents Green solvents and Alternative methods Green Chemistry, Green solvents – Alternative techniques in organic synthesis. (12L)

USC DSE ChP 05(Organic)

Practicals

- A) Identification of organic compound on the basis of NMR data.
- B) 1. Estimation of hydroxyl number of a polymer using colorimetric method..
2. Estimation of the amount of HCHO in the given solution by sodium sulphite method
- C) 1. Preparation of nylon 66
2. Preparation of urea-formaldehyde resin.
- D) Green chemistry synthesis of organic compound by using micro wave technic.

Reference Books

- 1) Chemistry for Degree Student, Dr. R. L. Madan, S. Chand and Co. New Delhi.
- 2) Organic Chemistry by R. T. Morrison and R. T. Boyd, 6th edition, PHI.
- 3) Organic Chemistry by Pine, 5th edition.
- 4) Inorganic Chemistry Vol. I, II and III by Mukharjee, Singh and Kapoor – Willey Eastern.
- 5) Organic Chemistry by S. K. Ghosh.
- 6) Reaction Mechanism in Organic Chemistry by S. M. Mukharjee and S. P. Singh.
- 7) Spectroscopy of Organic Compounds by P. S. Kalsi.
- 8) Stereochemistry and Mechanism through solved problems by P.S. Kalsi.
- 9) Organic Chemistry by TWG Solomons, 4th edition, John Wiley.
- 10) Hand book of Organic Analysis by H. J. Clarke, Arnold Heinmen.
- 11) Text book of Practical Organic Chemistry by A. I. Vogel.
- 12) Text book of Organic Chemistry by Jamode, Ganar, Makode, Waghmare, Mahaja, Toshinwal.
- 13) Text book of Organic Chemistry by P.S. Kalsi published by Macmillian India Ltd. 1999, Delhi.
- 14) Practical Organic Chemistry by F. G. Mann. B. C. saunders, Orient Longman.
- 15) Comparative Practical Organic Chemistry (Qualitative Analysis) by V. K. Ahluwalia and Sunita Dhingra, Orient Longman.
- 16) Comprehensiv Practical Organic Chemistry (Preparation and Qualitative Analysis) by V. K. Ahluwalia and Renu Agrawal. Orient Longman.

USC DSE ChT10

Discipline Specific Elective Chemistry II (Physical)

UNIT- I

Electrochemistry – I :

Electrical transport: Conductance in metals (electronic) & in electrolyte solutions (ionic conductance), conductivity of electrodes, specific, equivalent and molar conductance, measurement of equivalent conductance, variation of equivalent & specific conductance with dilution, mobility of ions & Kohlrausch's law, Application of Kohlrausch's law & conductance for the determination of degree of dissociation, dissociation constant of acids, solubility of sparingly soluble salt, conductometric titrations (Acid-base & precipitation titrations).

Arrhenius theory of electrolyte dissociation & its limitation, Debye-Huckel theory (elementary treatment). Relaxation effect, Electrophoretic effect and Onsager equation. (12 L)

UNIT-II

Electrochemistry – II:

(A) Galvanic cells, irreversible & reversible cells, emf of cells & its measurement, calculation of thermodynamic quantities of a cell reactions (ΔG , ΔH & ΔS & equilibrium constant) Types of processes, Working and counter electrodes, Faraday's laws (I and II) of electrolysis, Faradaic processes, Nonfaradaic processes, Ideally polarized electrodes (6L)

B) Migration of ions, velocity of ions & change in concentration around electrode, transport number: definition & determination by Hittorf's method & moving boundary method, factors affecting transport number of ions, relation between transport number & ionic conductance determination of activity coefficients and transference numbers. (6L)

UNIT- III

Types of reversible electrodes: gas electrode, metal-metal ion electrode, amalgam electrode, metal insoluble salt-anion, redox electrodes, Half cell reactions, Nernst equation, calculation of cell emf from single electrode potential, reference electrodes, standard electrode potential.

Concentration cells with & without transference, liquid-junction potential, salt bridge & its functions, Applications of emf measurements in : (i) pH- determination using hydrogen electrode, quinhydrone electrode & glass electrode (ii) potentiometric titration (Acid –Base and Redox titrations). (iii) Solubility product of sparingly soluble salt, Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation). (12L)

UNIT-IV

Quantum Mechanics

A) Failure of classical mechanics: Explanation on the basis of Black body radiation, Photoelectric effect, heat capacity of solids and Bohr's model of Hydrogen atom (No derivation). Planck's quantum theory. De Broglie's hypothesis (Derivation and experimental proof). Heisenberg's uncertainty principle (Explanation and experimental proof).

B) Introduction to wave functions (Ψ), well behaved wave functions. Interpretation of wave function (Ψ) and its square (Ψ^2). Schrodinger wave equation. Normalized and orthogonal wave functions (only qualitative idea no problems). Introduction to operators. Postulates of quantum mechanics, Derivation of Schrodinger wave equation from postulates of quantum mechanics. Particle in a one dimensional box: derivation of energy and normalized wave function. Graphical representation of Ψ and its square Ψ^2 . Applications of particle in a one dimensional box. Numerical problems. (12 L)

USC DSE ChP 06 (Physical Chemistry)

Practicals

- 1) To determine the strength of strong acid and a weak acid in a given mixture conductometrically by titrating it with standard alkali solution.
- 2) To determine the solubility and solubility product of a sparingly soluble salt conductometrically.
- 3) To titrate potentiometrically ferrous ammonium sulphate solution using potassium

dichromate solution as titrate and calculate the redox potential of $\text{Fe}^{2+}/\text{Fe}^{3+}$ system on hydrogen scale.

4) To determine the dissociation constant of weak acid potentiometrically by titrating it against alkali.

5) To study the saponification of ethyl acetate conductometrically.

6) To determine strength of strong acid with strong base potentiometrically.

Reference Books

1) Physical Chemistry : Walter J. Moore, 5th edn. New Delhi.

2) Physical Chemistry : G. M. Barrow, McGraw Hill, Indian Edn.

3) Principle of Physical Chemistry : Maron and Prutton.

4) Principles of Physical Chemistry : Puri and Sharma

5) Physical Chemistry : P. W. Atkins, 4th Edn.

6) Text book of Physical Chemistry : P. L. Sony O. R. Dhurma.

7) Physical Chemistry : Levine

8) Practical Physical Chemistry : Palit and De.

9) Practical Physical Chemistry : Yadao

10) Practical Physical Chemical : Khosla.

11) An introduction to synthetic drugs, Himalaya publishing house by Sing and Rangnekar. 28) Spectroscopy, Goel Publishing house by B. K. Sharma.

USC DSE ChT 11

Discipline Specific Elective Chemistry III (Industrial Chemicals AND Environment)

Unit I

Industrial Gases and Inorganic Chemicals

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.(2L)

Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.(10 Lectures)

Unit II

Industrial Metallurgy

Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology. (4 L)

Environment and its segments

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur. (2L)

Biocatalysis

Introduction to biocatalysis: Importance in “Green Chemistry” and Chemical Industry.(6L)

Unit III

Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution. Pollution by SO₂, CO₂, CO, NO_x, H₂S and other foul smelling gases. Methods of estimation of CO, NO_x, SO_x and control procedures.

Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates. (12 L)

Unit IV

Energy & Environment

Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc.

Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

(12L)

USC DSE ChP 07(Industrial Chemicals AND Environment)

Practicals

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO_3 and potassium chromate).
6. Estimation of total alkalinity of water samples (CO_3^{2-} , HCO_3^-) using double titration method.
7. Measurement of dissolved CO_2 .
8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Preparation of borax/ boric acid.

Reference Books

- 1 E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
 - 2 R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
 - 3 J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
 - 4 S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi.
 - 5 K. De, Environmental Chemistry: New Age International Pvt., Ltd, New Delhi.
 - 6 S. M. Khopkar, Environmental Pollution Analysis: Wiley Eastern Ltd, New Delhi.
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USC DSE ChT 12

Discipline Specific Elective Chemistry IV (Green Chemistry)

UNIT I

Introduction to Green Chemistry

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry.

Principles of Green Chemistry and Designing a Chemical synthesis Twelve principles of Green Chemistry with their explanations and examples; Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products (Atom Economy); prevention/ minimization of hazardous/ toxic products; designing safer chemicals – different basic approaches to do so; selection of appropriate auxiliary substances (solvents, separation agents), green solvents, solventless processes, immobilized solvents and ionic liquids; (12 L)

UNIT II

Examples of Green Synthesis/ Reactions

Green Synthesis of the following compounds: adipic acid, catechol, BHT, methylmethacrylate, urethane, aromatic amines (4-aminodiphenylamine), benzyl bromide, acetaldehyde, disodium iminodiacetate (alternative to Strecker synthesis), citral, ibuprofen, paracetamol, furfural.

Microwave assisted reactions in water: Hofmann Elimination, Hydrolysis (of benzyl chloride, benzamide, n-phenyl benzamide, methylbenzoate to benzoic acid), Oxidation (of toluene, alcohols).

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

Microwave assisted solid state reactions: Deacetylation, Deprotection. Saponification of esters, Alkylation of reactive methylene compounds, reductions, synthesis of nitriles from aldehydes; anhydrides from dicarboxylic acid; (12L)

UNIT III

Ultrasound assisted reactions: Esterification, saponification, substitution reactions,

Alkylations, oxidation, reduction, coupling reaction, Cannizzaro reaction, Strecker synthesis,

Reformatsky reaction. Selective methylation of active methylene group using dimethylcarbonate; Solid-state polymerization of amorphous polymers using diphenylcarbonate; Use of “Clayan”, a nonmetallic oxidative reagent for various reactions; Free Radical Bromination; Role of Tellurium in organic syntheses; Biocatalysis in organic syntheses. (12L)

UNIT IV

Future Trends in Green Chemistry Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; oncovalent derivatization; Green chemistry in sustainable development. Energy requirements for reactions - use of microwaves, ultrasonic energy; selection of starting materials; avoidance of unnecessary derivatization – careful use of blocking/protecting groups; use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; designing of biodegradable products; prevention of chemical accidents; strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. (12 L)

USC DSE ChP 08(Green Chemistry)

Practicals

1. Safer starting materials

The Vitamin C clock reaction using Vitamin C tablets, tincture of iodine, hydrogen peroxide and liquid laundry starch.

1) Effect of concentration on clock reaction

2) Effect of temperature on clock reaction. (if possible)

2. Using renewable resources

Preparation of biodiesel from vegetable oil.

3. Avoiding waste

Principle of atom economy.

Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry.

Preparation of propene by two methods can be studied

(I) Triethylamine ion + OH⁻ → propene + trimethylpropene + water

(II) 1-propanol + H₂SO₄/□ → propene + water

The other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy.

4. Use of enzymes as catalysts

Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide

Alternative Green solvents

5. Diels Alder reaction in water

Reaction between furan and maleic acid in water and at room temperature rather than in benzene and reflux.

6. Extraction of D-limonene from orange peel using liquid CO₂ prepared from dry ice.

7. Mechanochemical solvent free synthesis of azomethines

8. Co-crystal controlled solid state synthesis (C2S3) of N-organophthalimide using phthalic anhydride and 3-aminobenzoic acid.

Reference Books

1 Anastas, P.T & Warner, J.C. Green Chemistry: Theory and Practice, Oxford University Press (1998).

2 Kirchoff, M. & Ryan, M.A. Greener approaches to undergraduate chemistry experiment. American Chemical Society, Washington DC (2002).

3 Ryan, M.A. Introduction to Green Chemistry, Tinnesand; (Ed), American Chemical Society, Washington DC (2002).

4 Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. I.K. Green Chemistry Experiment: A monograph International Publishing House Pvt Ltd. New Delhi. Bangalore CISBN 978-93-81141-55-7 (2013).

5 Cann, M.C. & Connelly, M. E. Real world cases in Green Chemistry, American Chemical Society (2008).

6 Cann, M. C. & Thomas, P. Real world cases in Green Chemistry, American Chemical Society (2008).

7 Pavia, D. L. Lamponan, G. H. & Kriz, G.S. W B Introduction to organic laboratory

Distribution Of Marks For Practical Examination

Time 4-5 hours (One Day Examination) Marks 30

USC DSE ChP 05 (Experiment) (In examination Experiment A is compulsory (4M)+ any one from B or C or D (8M) **12**

USC DSE ChP 06 (Experiment) (In examination **any one**) **12**

USC DSE ChP 07 (Experiment) (In examination **any two**) **12**

USC DSE ChP 08 (Experiment) (In examination **any one**) **12**

ANY TWO FROM ABOVE FOUR

TOTAL MARKS 12+12= 24

Viva-Voce 03

Record 03

Total : 30 marks

Skill Enhancement Course (SEC)

(Choose one)

SEC I

1. Pharmaceutical Chemistry

Drugs & Pharmaceuticals

Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, Ibuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).

Fermentation

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

Practicals

1. Preparation of Aspirin and its analysis.
2. Preparation of magnesium bisilicate (Antacid).
3. Preparation of Paracetamol and its analysis.
4. To perform analytical method validation of Paracetamol in pure and tablet form by using UV spectrophotometric method.

Reference Books:

1 G.L. Patrick: Introduction to Medicinal Chemistry, Oxford University Press, UK.

2Hakishan, V.K. Kapoor: Medicinal and Pharmaceutical Chemistry, Vallabh

Prakashan, Pitampura, New Delhi.

3 William O. Foye, Thomas L., Lemke , David A. William: Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd. New Delhi

SEC II

Chemistry of Cosmetics& Perfumes

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

Practicals

1. Preparation of talcum powder.
2. Preparation of shampoo.
3. Preparation of enamels.
4. Preparation of hair remover.
5. Preparation of face cream.
6. Preparation of nail polish and nail polish remover.

Reference Books:

- 1 E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
- 2 P.C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
- 3 B.K. Sharma: Industrial Chemistry, Goel Publishing House, Meerut.

Distribution Of Marks
Skill Enhancement course

Theory -15Marks
Practical -35 Marks

For theory examination

15 marks multiple choice question paper is to be set by the college and evaluation is done by college.

For practical Examination:

- 1) One practical of 10 marks
- 2) One survey based project report 20 marks
- 3) Viva 5 marks

Total marks =15+35=50

Discipline Specific Elective Chemistry
(Choose any two)
B.Sc.III (Semester VI) (CBCS)
USC DSE ChT 13

Discipline Specific Elective Chemistry V (Inorganic)

UNIT-I

A) Qualitative and quantitative aspects of analysis:

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals. (6 L)

B) Flame Photometry:

Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Effect of solvent in flame photometry .Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Limitations of flame photometry. Application of Flame photometry .Experimental procedure for quantitative analysis (6L)

UNIT-II:

A) Separation Techniques:

a) Chromatography: Classification, Principle, Technique and Application of Paper and Column Chromatography.

b) Ion- Exchange: Types of ion exchange resins, Equilibria and ion exchange capacity, Application in separation of binary mixtures.

c) Solvent Extraction: Principle and Classification , Factors influencing extraction and Application in chemistry. (6L)

B) Fertilizer:

Classification, Chemical fertilizer with example, advantages and disadvantages of chemical fertilizer, manures and compost and their advantages over chemical fertilizers. (3L)

C) Basic Principal of Soil Chemistry:-

Introduction of soil and its type, Chemical Analysis of soil, Collection of soil Sample, Method of analysis, Soil pH, Soil Salinity, Organic carbon, available phosphorous and potassium. Lime requirements. (3 L)

UNIT-III:

A) Organometallic Chemistry:-

Definition, Nomenclature and Classification of Organometallic compounds. Preparation properties and application of Alkyl and Aryls of Al, Hg and Sn. A brief account of metal ethylenic complexes (Structure only). Homogeneous Hydrogenation (Wilkinson's Catalyst reaction). (6 L)

B) Nanomaterials: Basic Concepts in nanomaterials, classifications, preparation of gold and silver nanomaterial. Carbon nanotubes and inorganic nanowires. Bioinorganic nanomaterial. (6L)

UNIT-IV:

Water Pollution:

A) Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems.

B) Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal.

C) Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.

(12L)

USC DSE ChP 09(Inorganic)

Practicals:

- 1) Ion Exchange Method, separation and estimation of Mg(II) and Zn(II)
- 2) Chromatographic Separation of Binary Mixtures (at least two) containing Cu(II), CO(II) and Ni(II) ions by paper chromatography and determination of R_f Values.
- 3) verification of F, Q, and T test and rejection of data for acid base titration..
- 4) Analysis of soil:
 - 1) Determination of pH of soil.
 - 2) Total soluble salt
 - 3) Estimation of calcium, magnesium, phosphate, nitrate.

5) Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO_3 and potassium chromate).

6) Estimation of total alkalinity of water samples (CO_3^{2-} , HCO_3^-) using double titration method.

Reference Books

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia – S. Naginchand & Co. Delhi.
2. Text book of Inorganic Chemistry by A. K. De. Wiley East Ltd.,
3. Selected Topics in Inorganic Chemistry by Malik, Tuli and Madan – S. Chand and Co.
4. Modern Inorganic Chemistry by R. C. Agrawal, Kitab Mahal.
5. Instrumental Methods of analysis by Chatwal and Anand, Himalaya Publishing House.
6. Concise Inorganic Chemistry by J. D. Lee, ELBS.
7. Inorganic Chemistry by J. E. Hoheey – Harper and Row.
8. Fundamental concepts of Inorganic Chemistry by E. S. Gilreath, McGraw Hill book Co.
9. Modern Inorganic Chemistry by W. L. McGraw Hill Int.
10. Chemistry Facts, Patterns and Principles by Kneen, Rogers and Simpson, ELBS.
11. Theoretical Principles of Inorganic Chemistry by G.S. Manku, Tata McGraw Hill.
12. Inorganic complex compounds by Murmann, Chapman and Hall.
13. Text book of Inorganic Chemistry by K. N. Upadhyaya, Vikas Publishing House, Delhi.
14. Advanced Practical Inorganic Chemistry by Gurdeep Raj. Goel Publishing House, Meerut.
15. Co-Ordination Chemistry by D. Banerjee, TMH Publication.
16. Text book of Inorganic Chemistry by Marathe, Bhadange, Mopari and Kubade.
17. Physico Chemical Techniques of Analysis – P.B. Janarthnam Vol – I & II- Asian Publication

Discipline Specific Elective Chemistry VI (Physical)

UNIT I

A) Photochemistry :-

Interaction of radiation with matter, difference between thermal and photochemical process, Beer –Lamberts, laws of photochemistry :Grothus-Draper law, Stark-Einstein law, Jablonski diagram depicting various processes (nonradiative and radiative) fluorescence, phosphorescence, chemiluminescence, quantum yield, determination of quantum yield of reactions, causes for low and high quantum yields. Some examples of photochemical reactions (e.g. Photochemical decomposition of Hydrogen iodide, Photosynthesis of HBr from H_2 and Br_2 and photosynthesis of HCl from H_2 and Cl_2 Photosensitized reactions. Energy transfer processes. (8 L)

B) Dipole Moment :-

Electrical dipole moment, polarizability of molecules (Clausius-Mosotti equation), orientation of dipoles in an electric field. Determination of dipole moment. Bond moments. Group moments for benzene derivatives. Application of dipole moment to (i) % ionic character (ii) Shape of molecules, (iii) study of geometrical isomers and (iv) substituted benzene molecules. (4 L)

UNIT-II

Spectroscopy

A) Rotational Spectroscopy:

Introduction to spectroscopy, Dipole moment and Rotational Spectra. Rotational spectra of diatomic molecules, Energy levels of rigid rotor. Selection rule for transition between energy levels. Expression for wave number (cm^{-1}) of spectral lines in terms of rotational constant (B) and rotational quantum number (J). Intensity of spectral lines. Application of rotational spectra for determination of bond length of diatomic molecules. Introduction to non-rigid rotor.[6 L]

B) Vibrational Spectroscopy:

Energy levels of simple harmonic oscillator, Energy level diagram, relative populations of energy levels. Selection rule for pure vibrational spectra (harmonic oscillations), Force constant. Anharmonic oscillator, Morse equation, selection rules, idea of overtones. Degrees of freedom and normal modes of vibration for polyatomic molecules. Idea of vibrational frequencies of different functional groups. (6 L)

UNIT-III

A) Surface Chemistry:-

Adsorption, Chemisorptions, Application of adsorption, adsorption of gases by solid, freundlich adsorption isotherm , Langmuirs theory of adsorption, Adsorption from solution , Adsorption chromatography. (6 L)

B) Colloidal Chemistry:-

Type of colloidal system , its classification, lyophilic and lyophobic sol, partical size range, preparation of colloidal solution by condensation method , ultra filtration, properties of colloidal system, charge on colloidal particles, gold number, electrical properties: electrophoresis and electro Osmosis, Surfactant definition, types , miscelle concentration, effect of temperature on CMC. (6 L)

UNIT IV

Nuclear Chemistry

The atom, nucleus and outer sphere, classification of nuclides, nuclear stability and binding energy. Discovery of radioactivity, types of radioactivity, general characteristics of radioactive decay and decay kinetics, Measurements radioactivity, gaseous ion collection method, proportional and G.M. counter.

Applications of radioactivity Radiochemical principles in the use of tracers,

Typical applications of radioisotopes as a tracer i) Chemical investigations- reaction mechanism,

ii) Structure determination- phosphorus pentachloride and thiosulphate ion

iii) Age determination- by Carbon-14 dating and Uranium-Lead/ Thorium-Lead Ratio

iv) Medical applications-Assess the volume of blood in patients body, Goiter (12L)

USC DSE ChP10(Physical)

Practicals

- 1) To verify Beer – Lambert Law for $\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ and determining the concentration of the given solution of the substance from absorption.
- 2) To verify the Freundlich adsorption isotherm by acetic acid on activated charcoal
- 3) Determination of polarizability of given molecule by Abbe's refractometer.
- 4) To determine CMC of soap solution.
- 5) To study effect of temperature on CMC on soap solution.

Reference Books

1. Physical Chemistry: Walter, J. Moore, 5th edn., New Delhi.
2. Physical Chemistry: G.M. Barrow, McGraw Hill, Indian Edn.
3. Principles of Physical Chemistry: Maron and Prutton
4. Principles of Physical Chemistry: Puri, Sharma and Pathaniya.
5. Text book of Physical Chemistry: P.L. Sony, O.P. Dharma.
6. Physical Chemistry: Levine.
- 7 Practical Physical Chemistry: Palit and De.
8. Practical Physical Chemistry: Yadao.
9. Practical Physical Chemistry: Khosla.
- 10 Laboratory Manual of Physical Chemistry W.J. Popiel.
11. Principles of Soil Science : M. M. Rai (4th addition) McMillan publication.
- 12 Advance physical chemistry : J. N. Gurtu & A. Gurtu, Pragati prakashan, Meeru

USC DSE ChT 15

Discipline Specific Elective ChemistryVII

(Inorganic Materials of Industrial Importance)

UNIT I

Silicate Industries

Glass: Glassy state and its properties, classification (silicate and non-silicate glasses).

Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass,

Ceramics: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.

Cements: Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements. (12 Lectures)

UNIT II

Fertilizers:

Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; mixed fertilizers, potassium chloride, potassium sulphate. (4 L)

Surface Coatings:

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic andelectroless), (8 L)

UNIT III

Batteries:

Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solar cell and polymer cell.

(4 L)

Alloys:

Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization, dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). (8 L)

UNIT IV

Catalysis: General principles and properties of catalysts, Deactivation or regeneration of catalysts, enzyme as nature's catalyst, Compare the activity and reactivity of man-made catalyst and enzyme, factors which affect enzyme activity, some industrially important catalytic processes- Haber's, Ostwald's process, Phase transfer catalysts, application of zeolites as catalysts. (8 L)

Chemical explosives:

Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants. (4 L)

USC DSE ChP11(Inorganic Materials of Industrial Importance)

Practicals

1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Electroless metallic coatings on ceramic and plastic material.

5. Determination of composition of dolomite (by complexometric titration).
6. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
7. Analysis of Cement.
8. Preparation of pigment (zinc oxide).

:

Reference Books

- 1 E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
- 2 R. M. Felder, R. W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
- 3 W. D. Kingery, H. K. Bowen, D. R. Uhlmann: Introduction to Ceramics, Wiley Publishers, New Delhi.
- 4 J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
- 5 P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
- 5R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.
- 6 B. K. Sharma: Engineering Chemistry, Goel Publishing House, Meerut

USC DSE ChT 16

Discipline Specific Elective Chemistry VIII (Polymer Chemistry)

Unit I

Introduction and history of polymeric materials: Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers. (4L) Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes,

Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems. (8 L)

Unit II

Kinetics of Polymerization:

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques. (6L)

Polymer Additives

Fillers & Reinforcement, Plasticizers, Antioxidants & Thermal Stabilizers (Heat Stabilizers), Ultraviolet stabilizers, Fire retardants, Colourants, Antistatic agents & Curing agents (6 L)

UNIT III

Determination of molecular weight of polymers (M_n , M_w , etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance.(4 L)

Polymer Solution – Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.(8 L)

UNIT IV

Nature and structure of polymers-Structure Property relationships.(2 L)

Properties of Polymers (Physical, thermal, Flow & Mechanical Properties).

Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac),

polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylenesulphide)polypyrrole, polythiophene)].(10 L)

USC DSE ChP 12(Polymer Chemistry)

Practicals

1. Polymer synthesis

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).

a. Purification of monomer

b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutyronitrile (AIBN)

2 Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein

a. Preparation of IPC

b. Purification of IPC

c. Interfacial polymerization

3. Redox polymerization of acrylamide

4. Precipitation polymerization of acrylonitrile

5. Preparations of novalac resin/resold resin.

6. Microscale Emulsion Polymerization of Poly(methylacrylate).

Polymer characterization

1. Determination of molecular weight by viscometry:

(a) Polyacrylamide-aq. NaNO₂ solution

(b) (Poly vinyl propylidene (PVP) in water

2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol)

(PVOH) and the fraction of “head-to-head” monomer linkages in the polymer.

3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).

4. Testing of mechanical properties of polymers.

Reference Books

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

Distribution Of Marks For Practical Examination

Time 4-5 hours (One Day Examination) Marks 30

USC DSE ChP 09 (any two experiment) 12
USC DSE ChP 10 (any one experiment) 12
USC DSE ChP 11 (any one experiment) 12
USC DSE ChP 12 (any one experiment) 12

ANY TWO FROM ABOVE FOUR

TOTAL MARKS 12+12= 24

Viva-Voce 03

Record 03

Total : **30 marks**

Skill Enhancement Course (SEC)

B.Sc. III Semester VI

(Choose one)

SEC-III

PESTICIDE CHEMISTRY

General introduction to pesticides (natural and synthetic), benefits and adverse

effects, changing concepts of pesticides, structure activity relationship, purpose of formulations of pesticides, different types of formulations synthesis and technical manufacture and uses of representative pesticides in the following classes:

Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion);

Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Practicals

1 To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications.

2 Preparation of simple organophosphates, phosphonates and thiophosphates

Reference Book:

1 R. Cremllyn: Pesticides, John Wiley.

SEC-IV

ANALYTICAL CLINICAL BIOCHEMISTRY

Basic understanding of the structures, properties and functions of carbohydrates, lipids and proteins:

Review of concepts studied in the core course

Carbohydrates: Biological importance of carbohydrates, Metabolism, Cellular currency of energy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle.

Isolation and characterization of polysachharides.

Proteins: Classification, biological importance; Primary and secondary and tertiary structures of proteins: α -helix and β -pleated sheets, Isolation, characterization, denaturation of proteins.

Enzymes: Nomenclature, Characteristics (mention of Ribozymes), Classification; Active site, Mechanism of enzyme action, Stereospecificity of enzymes, Coenzymes and cofactors, Enzyme inhibitors, Introduction to Biocatalysis: Importance in “Green Chemistry” and Chemical Industry.

Lipids: Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and underlying applications.

Lipoproteins.

Properties, functions and biochemical functions of steroid hormones.

Biochemistry of peptide hormones.

Structure of DNA (Watson-Crick model) and RNA, Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation, Introduction to Gene therapy.

Enzymes: Nomenclature, classification, effect of pH, temperature on enzyme activity, enzyme inhibition.

Biochemistry of disease: A diagnostic approach by blood/ urine analysis.

Blood: Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Anaemia, Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin.

Urine: Collection and preservation of samples. 6. Formation of urine. Composition and estimation of constituents of normal and pathological urine.

Practicals

Identification and estimation of the following:

1. Carbohydrates – qualitative and quantitative.
2. Lipids – qualitative.
3. Determination of the iodine number of oil.
4. Determination of the saponification number of oil.
5. Determination of cholesterol using Liebermann- Burchard reaction.
6. Proteins – qualitative.
7. Isolation of protein.
8. Determination of protein by the Biuret reaction.
9. Determination of nucleic acids

Reference Books:

1. T.G. Cooper: Tool of Biochemistry.
2. Keith Wilson and John Walker: Practical Biochemistry.
3. Alan H Gowenlock: Varley's Practical Clinical Biochemistry.
4. Thomas M. Devlin: Textbook of Biochemistry.
5. Jeremy M. Berg, John L Tymoczko, Lubert Stryer: Biochemistry.
6. G. P. Talwar and M Srivastava: Textbook of Biochemistry and Human Biology.
7. A.L. Lehninger: Biochemistry.
5. Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.
6. Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India.
7. Freifelder, D. Physical Biochemistry 2nd Ed., W.H. Freeman and Co., N.Y. USA (1982).
8. Cooper, T.G. The Tools of Biochemistry, John Wiley and Sons, N.Y. USA.16 (1977).
9. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall.

10. Vogel, A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Prentice Hall.
11. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).

Distribution Of Marks

Skill Enhancement course

Theory -15Marks

Practical -35 Marks

For theory examination

15 marks multiple choice question paper is to be set by the college and evaluation is done by college.

For practical Examination:

- 1) One practical of 10 marks
- 2) One survey based project report 20 marks
- 3) Viva 5 marks

Total marks =15+35=50