**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 L]**

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

**(D) Study of Silicates**:Classification, Preperation,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. Salvation 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, valance bond theory and Band theory to explain nature of conductors, insulators & semiconductors (intrinsic and extrinsic). **[3L]**

**(C)Acids and Bases**: Bronsted Lowery 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-analogus (Groups Cr-Mo-W, Fe-Rn-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 isolatic 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, Raoults 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 thermodynamixs, 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) & Gibb's free energy (G) & their properties, standard free energies, effect of temperature on free energy (Gibb's-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, Raoults 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 (1), 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:

$I_2(aq) + I^-(aq) \leftrightarrow I_3^-(aq)$

$Cu^{2+}(aq) + xNH_2(aq) \leftrightarrow [Cu(NH3)x]^{2+}$

### Phase Equilibria

a) Construction of the phase diagram of a ternary system ( water-acetic acid-chloroform)

b) 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 $H_2SO_4$ 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 |
| 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. Barrrow, McGraw Hill, Indian Edn.
17. Principle of Physical Chemistry : Maron and Prutton.
18. Principles of Physcial Chemistry : Puri and Sharma
19. Physical Chemistry : P. W. Atkins, 4th Edn.
20. Text book of Physical Chemistry : P. L. Sony O. R. Dhrma.
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:- Froast, Latimer and pourbax 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 Stabilisatation 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 $[Ti(H_2O)_6]^{3+}$ and $[Cu(H_2O)_6]^{2+}$ 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) Colorimetery And Spectrophotometery**: Principles of photometery: 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, $NO_2$, 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]**

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**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 Definations). Synthesis and Applications of (i) Aspirin (ii) Paracetamol and their side effects. Uses of detol (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)

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

B) Colorimetry /spectrophotometry : (08 Marks each)

i) Jobs method of determination of composition of Fe- SSA complex

ii) 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. Theorotical 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 inoraganic 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.