V SEMESTER BSc CHEMISTRY

PAPER - V : INORGANIC AND PHYSICAL CHEMISTRY
BSCCHCN501

Contact hours: 56 **Work Load: 4Hours/week** **Credit points:4**

Evaluation:Continuous Internal Assesment: 40Marks

Semester End Examination: 60Marks

Course Objectives:

i) To introduce the students to various theories of chemical bonding

ii) To make the students learn nuclear reactions and their applications.

iii)To introduce the students to quantum mechanical concepts, Schrodinger wave equation and its solutions.

iv) To make the students learn the structure and properties of main group elements which have large number of applications in daily life.

Course Specific outcomes:

After the completion of this course, students will

i) Understand the types of bonding in compounds and the theories to explain them

ii) Understand nuclear reactions, the importance of nuclear phenomenon, radiation chemistry & it's applications.

iii) Know the application of Quantum mechanics to particle in a box and hydrogen atom.

iv) Know chemistry of main group elements and acid base concepts.

v) Know chemical dynamics and kinetics of chemical reactions.

UNIT - I

Chemical Bonding: **8h**

VSEPR model, shapes of molecules-ClF_3, ICl_4^-, TeF_5^-, I_3^-, $TeCl_6^{2-}$, XeF_6, IF7, Bent rules and energetics of hybridization; electronegativity and partial ionic character; Bonds- Multicenter, Synergic and Agostic bonding. Molecular orbital theory: LCAO and MO diagrams of heteronuclear diatomic (CO, HF, ICl) molecules.

M-M bond and metal atom clusters, halide clusters, bonding in $[Re_2Cl_8]^{2-}$.

Nuclear Chemistry: **6h**

The atomic nucleus-elementary particles, quarks, classification of nuclides based on Z and N values, nuclear stability, nuclear potential, binding energy. Nuclear Models: Liquid drop model, Fermi gas model. Radioactivity, radioactive decay kinetics, Parent-daughter decay-growth relationship-secular and transient equilibria. Applications of radioactive isotopes. (Numerical problems to be worked out wherever necessary).

UNIT – II

Chemistry of main group elements: 8**h**

Structure and bonding in boranes, carboranes, Styx Number, Wades rules, borazines, phosphazenes, S, N- compounds. Silicates- Classification, structures, isomorphous replacement, pyroxenes, layered and vitreous silicates, zeolites and molecular sieves.

HSAB concept: 6**h**

Basis of HSAB concept, acid-base strength, hardness and softness, symbiosis, applications of HSAB concept; Acid- base concept in non-aqueous media, reactions in BrF_3, N_2O_4, anhydrous H_2SO_4, CH_3COOH.

UNIT – III

Quantum Mechanics: **10h**

Concepts of Operators: Laplacian, Hamiltonian, Linear and Hermitian operators. Algebra of operators, commutator operator. Eigenfunctions and eigenvalues. Solutions of Schrödinger wave equation for a particle in a three-dimensional box, particle in a ring. Quantum mechanical degeneracy, tunneling (no derivation).

Formulation of Schrodinger equation to hydrogen atom in spherical polar co-ordinates (no derivation). Quantum numbers and their characteristics. Coupling of Angular momenta. Russell-Saunders and JJ-coupling, Term symbols. Zeeman effect.

Chemical Dynamics -I **4h**

Review of theories of reaction rate- Collision theory and Transition state theory, Comparison of collision theory with transition state theory, Arrhenius equation-characteristics, Significance of energy of activation, Temperature coefficient and its evaluation. Problems to be worked out wherever necessary. Introduction to fast reaction techniques.

UNIT – IV

Chemical Dynamics – II **6h**

Concept of Steady state kinetics, Chain reactions - chain length and chain inhibition, comparison of photochemical and thermal reactions, Mechanisms of thermal and photochemical reactions between hydrogen-bromine and hydrogen-chlorine. Comparative study of thermal and photochemical hydrogen-halogen reactions. Pyrolysis of acetaldehyde, Decomposition of ethane.

Radiation Chemistry: **4h**

Introduction. Radiation sources and units. Radiation dosimetry, dosimeter. Radiolysis of water (using gamma rays), radiolysis of gases and liquids. Application of radioisotopes in the study of organic reaction mechanism. Industrial applications.

Surface Chemistry: **4h**

Types of adsorption isotherms, Effect of temperature on adsorption. Gibbs adsorption isotherm and its significance, surface tension and surface energy. Derivation of BET equation. Determination of surface area using BET equation.

Recommended Books/References:

1. Basic Inorganic Chemistry- F. A. Cotton, G. Wilkinson and P. L. Gaus; John Wiley and sons. Inc, 6thedition (1999).
2. Advanced Inorganic Chemistry, 6th edition; F. A. Cotton and G. Wilkinson.
3. Inorganic Chemistry IV edition; J. E. Huheey, E. A. Keiter and R. L. Keiter, Addison; Wesley (1993).
4. Inorganic Chemistry, II edition, D. F. Shriver, P. W. Atkins and C. H. Langford, ELBS;

Oxford UniversityPress, 1994.
5. Chemistry of elements; N. N. Greenwood and A. E. Earnshaw, Butterworth Heinemann (1997).
6. Concise Inorganic Chemistry, 5th edition; J. D. Lee (1996).
7. Essentials of nuclear chemistry, 4th edition; H. J. Arniker, NAIL publishers (1995); Chapters 1, 3 and 4.
8.Nuclear and Radioactive chemistry; Friedlander, Kennedy and Miller; Chapters 8 and 9.
9. Inorganic Chemistry, 3rd Edition; Gary. L. Miessler and Donald . A. Tarr (2007).
10. Physical Chemistry, P. W. Atkins, Julio de Paula, ELBS, 7th edition, (2002).
11. Physical Chemistry: A Molecular Approach, McQuarie and Simon, Viva, New Delhi, (2001).
12. Introduction to Quantum Chemistry, A. K. Chandra, Tata McGraw Hill, (1988).
13. Quantum Chemistry, Ira. N. Levine, Prentice Hall, New Jersey, (1991).
14. Quantum Chemistry, R. K. Prasad, New Age International, 2nd edition, (2000).
15. Quantum Chemistry through problems and solutions, R. K. Prasad, New Age International (1997).
16. Chemical Kinetics- K. J. Laidler, McGraw Hill. Inc. New York (1988).
17. Principles of Chemical Kinetics - House J. E. Wm C Brown Publisher, Boston, (1997).
18. Kinetics and Mechanism - A. A. Frost and R. G. Pearson, John-Wiley, New York, (1961).
19. Chemical Kinetic Methods - C. Kalidas, New Age International Publisher, New Delhi (1995)
20. S.H. Maran and C. F. Pruton, 4th Edn., Oxford, & IBH publishing Co. Pvt. Ltd. New Delhi (1965).
21. Physical Chemistry- P. Atkins and J. D. Paula, 9th Edn., Oxford University Press (2010).
22. Biochemistry, - Geoffrey Zubay, 2nd Edn.,Macmillan Publishing Co. New York (1981).
23. Kinetics and Mechanism of Chemical Transformations- J. Rajaraman and J. Kuriakose, Mc Millan.

PRACTICAL V
INORGANIC & PHYSICAL CHEMISTRY PRACTICAL
BSCCHPN501

Work Load: 4Hours/week **Credit points:2**
Evaluation:Continuous Internal Assesment:25Marks
Semester End Examination: 25Marks

Course Objectives:

Students are made to learn
i) the practical aspects of preparation of complexes
ii) analysis of anions and cations. i
ii) instrumental methods of analysis

Course Specific outcomes:

i) Students will have practical experience in systematic semimicro qualiitative analysis of inorganic mixtures containing less familiar elements.

ii) Students acquire the knowledge in the preparation of inorganic complexes.

iii) Theoretical knowledge of students is strengthened with laboratory experiments using instruments like colorimeter, conductivity meter and potentiometer.

INORGANIC CHEMISTRY EXPERIMENTS

I Semi micro qualitative analysis of mixtures containing **two anions, two common cations and one less familiar elements**: W, Mo, Ce, Zr, V and Li. (Any five combinations).

II Preparation of inorganic complexes:

1. Cis- and trans- potassium dioxalatodiaquachromium(III) complex [analysis of oxalate and chromium]
2. Hexamminecobalt(III)chloride [analysis of cobalt]
3. Preparation of pentamminechlorocobalt(III)chloride.

PHYSICAL CHEMISTRY EXPERIMENTS

I Colorimetric Experiments

1. Verification of Beer's Law for Cu^{2+} ion/ Fe^{2+} ion.
2. Estimation of Fe^{2+} ion concentration using EDTA through colorimetric method.

II Conductometric Experiments

1. Precipitation titration: conductometric titration of lithium sulphate versus $BaCl_2$.
2. Conductometric titration of weak acid versus weak base.

III Potentiometric Experiments

1. Determination of single electrode potential of M^{2+}/M and estimate the given unknown concentration (Zn^{2+}/Zn, Cu^{2+}/Cu)
2. Titration of weak acid against a strong base using quinhydrone electrode and calculation of pKa and Ka of the weak acid.

Recommended Books/References:

1. Vogel's Text book of Qualitative Chemical Analysis, J. Bassett, G. H. Jeffery and J. Mendham, ELBS (1986).
2. Vogel's text book of Quantitative Chemical Analysis, 5th Edition, J. Bassett, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).

3. Inorganic Semimicro Qualitative Analysis, V. V. Ramanujam; The National Pub. Co. (1974).
4. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co., London (1972).
5. Findlays practical physical chemistry revised by P. B. Levitt, Longman's London (1966).
6. Experiments in Physical Chemistry by Shoemaker and Garland, McGraw Hill International Edn. (1966)
7. Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publications Meerut (1988)
8. Senior Practical Physical Chemistry by B. C. Kosla, Simla Printers New Delhi (1987)
9. Experimental Physical Chemistry by Daniel et al., McGraw Hill, New York (1962).
10. Practical Physical Chemistry by A.M James and P. E. Pritchard, Longman's Group Ltd (1968)
11. Experimental Physical Chemistry by Wilson, Newcombe & others, Pergamon Press, New York (1962)
12. Experimental Physical Chemistry by R. C. Behra and B Behra, Tata McGraw, New Delhi (1983)
13. Experimental Physical Chemistry by V. D. Atavale and Parul Mathur, New Age International, New York (2
14. Physical Chemistry Laboratory Principles and Experiments by H. W. Salberg J. I. Morrow, S. R. Cohen an Green Macmillan publishing Co .new York.
15. Practical's in physical chemistry A. Modern Approach by P.S Sindhu, Mac. Millan Publishers Delhi (200 (1986).
16. Physical Chemistry of Surfaces- A. W. Adamson, Interscience Publisher Inc., New York (1967).
17. Surface Chemistry: Theory and Applications, J. J. Bikerman, Academic Press. New York (1972).

PAPER - VI: ORGANIC CHEMISTRY AND SPECTROSCOPY
BSCCHCN502
UNIT – I

Contact hours:56 Work Load:4Hours/week Credit points:4
Evaluation:
Continuous Internal Assesment:40Marks
Semester End Examination: 60Marks

Course Objectives:

i)To acquire detailed knowledge of the nature of bonding and reaction mechanism in organic molecules.

ii)To study carbohydrates, their Conformations and Configurations.

ii) To acquire the knowledge of structure and properties of heterocyclic compounds.

iv)To gain knowledge of molecular-vibrational, rotational, Raman and UV spectroscopic techniques.

Course Specific outcomes:
After the completion of the course students will be able to:

i) Differentiate aliphatic and aromatic compounds, understand the concept of resonance and write simple reaction mechanisms.
ii) Identify some of the heterocyclic compounds, their structure and physiological properties.
iii) have the basic knowledge of molecular spectroscopic methods like rotational, vibrational, Raman, NMR and UV Spectroscopy.

UNIT – I

Nature of Bonding in Organic Molecules: 4h

Delocalized chemical bonding, resonance, cross conjugation. Aromaticity. Huckel's rule of aromaticity. Aromatic systems with number of electrons other than six (azulene, tropone, tropolone and annulenes). Antiaromaticity. Aromaticity in benzenoids. Homo-aromaticity. Hyperconjugation. Tautomerism.

Reaction mechanism: 5h

Effect of structure on reactivity: - Resonance and field effects; steric effects.

Nucleophilic substitution reaction at a saturated carbon: S_N1, S_N2, and SET mechanisms. Effect of substrate structure, attacking nucleophile, leaving group.
Nucleophilic substitution in Aromatic compounds. S_NAr-Aryl mechanism.

Carbohydrates: 5h

Configuration, conformation of monosaccharides and classification. Interconversions of glucose and fructose, chain lengthening of aldoses (Kiliani-Fischer method), Chain shortening (Ruff degradation) Conversion of glucose and mannose-epimerisation, Mechanism of osazone formation-Amadori rearrangement, Formation of glycosides, ethers (methyl), esters (acetates). Configuration of glucose and fructose-deduction, Determination of ring size of monosaccharides (methylation and periodic acid method), Elucidation of cyclic structure of D(+) glucose, Mechanism of muta rotation.

.

UNIT – II

Heterocyclic Compounds: **7h**

Nomenclature of heterocyclic compounds. Structure, reactivity, synthesis and reactions of Pyrrole, Furan, Thiophene, pyrazole, oxazole, thiazole, pyrimidine, purine and indole.

Vitamins: **7h**

Biological importance and synthesis of Vitamins A, Vitamin B1 (thiamine), Vitamin B6 (pyridoxine), folic acid, pantothenic acid, riboflavin, Vitamin C, Vitamin E (α-tocopherol), Vitamin H (biotin), Vitamins K1 and K2.

UNIT – III

Molecular Spectroscopy – I

Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation(No mathematical derivation. Physical meaning only). **3h**

Rotation spectroscopy:

Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution. **4h**

Vibrational spectroscopy:

Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies. Fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. **4h**

Raman spectroscopy:

Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference. **3h**

UNIT – IV

Nuclear Magnetic Resonance (NMR) spectroscopy: **8h**

Introduction, origin of spectra, instrumentation of PMR spectrometer, solvents used, scales, number of signals for simple organic molecule, area of signals. Chemical shift and factors affecting chemical shift. Nuclear shielding and deshielding, Spin-spin splitting, coupling constants. Interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane and ethyl acetate.

UV Spectroscopy: **6h**

Types of electronic transitions, λmax, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λ max for the following systems: α,β-unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.

Recommended Books/References:

1. Advanced Organic Chemistry - Reactions, Mechanism and Structure, Jerry March, John Wiley (2008).
2. Advanced Organic Chemistry, F A Carey and R J Sundberg Plenum, (1990).
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman, (2000).
4. Structure and mechanism of Organic Chemistry, C K Ingold, Cornell University Press (1999).
5. Organic Chemistry, R T Morrison and R N Boyd, Prentice-Hall, (1998).
6. Modern Organic Reactions, H O House, Benjamin, (1972).
7. Principles of Organic Synthesis, R O C Norman and J M Coxon, Blackie Academic

and Professional, (1996).
8. Stereochemistry of Organic Compounds, D Nasipuri, New-Age International, (1999).
9. Stereochemistry of Carbon Compounds, E L Eliel, S H Wilen and L N Mander, John Wiley, (1994).
10. Stereochemistry, Potapov, MIR, Moscow, 1984.
11. Organic Chemistry, Volumes I and II, I L Finar, Longman, (1999).
12. Laideler K. J. and Meiser J. M. Physical Chemistry Third Edition (International)1999
13. Levine I. N., Physical Chemistry, Fourth Edition), McGraw-Hill (International), 1995.
14. McQuarrie D. A. and Simon J. D. Physical Chemistry- A Molecular Approach, University ScienceBooks, 1998.
15. P.W. Atkins: Physical Chemistry.
16. G.W. Castellan: Physical Chemistry.
17. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed.Tata McGraw-Hill:New Delhi (2006).
18. Brian Smith: Infrared Spectral Interpretations: A Systematic Approach.
19. Kemp, W. Organic Spectroscopy, Palgrave
20. Principles of Instrumental Analysis - 6th Edition by Douglas A. Skoog, F. James Holler, and StanleyCrouch (ISBN 0-495-01201-7).
21. Instrumental Methods of Analysis, 7th ed, Willard, Merritt, Dean, Settle.

PRACTICAL VI
ORGANIC CHEMISTRY PRACTICAL
BSCCHPN502

Work Load: 4Hours/week **Credit points:2**
Evaluation:
Continuous Internal Assessment: 25Marks
Semester End Examination: 25Marks

Course Objectives:
i)To make students learn synthesis of simple organic compounds and analysis of organic compounds with bifunctional groups.

Course Specific outcomes:
i) Students will know how to systematically identify organic compounds containing two functional groups by qualitative method.

ii) Students will be able to do simple single stage organic synthesis.

I- Preparation (one stage)

1. Cannizarro reaction: Benzaldehyde.
2. Pechmann reaction: Resorcinol and ethylacetoacetate.
3. Oxidation of Cyclohexanol.
4. Preparation of S-Benzylisothiuronium chloride.
5. Synthesis of p-Iodonitrobenzene
6. Synthesis of N-Phenyl-2,4-dinitroaniline.
7. Synthesis of 2,4,6-Tribromoaniline.

II- Qualitative analysis of bifunctional organic compounds

Systematic analysis and identification of organic compounds:

1. p-nitrobenzoic acid	2. p-nitrophenol	3. salicylic acid,
4. anthranilic acid,	5. o-chloroaniline,	6. p-nitroaniline,
7. p-nitrobenzaldehyde		

Recommended Books/References:

1. Laboratory manual of Organic Chemistry- B. B. Dey, M V Sitaraman and T R Govindachari, Allied Publishers, NewDelhi, (1996).
2. Practical Organic Chemistry - Mann and Saunders, (1980).
3. Textbook of Practical Organic Chemistry- A. I. Vogel, (1996).
4. Textbook of Quantitative Organic Analysis- A. I. Vogel, (1996).
5. A Handbook of Organic Analysis - Clarke and Hayes, (1964).
6. Comprehensive practical organic chemistry: Preparation and quantitative Analysis, V. K. Ahluwalia, R. Aggarwal, Universities Press (India), 2000.
7. Comprehensive practical organic chemistry: Qualitative analysis, V. K. Ahluwalia, S. Dhingra, Universities Press (India), 2000.
8. An advanced course in practical chemistry, A. Ghoshal, B. Mahapatra and A. Kr. Nad, New central book agency, Calcutta, 2000.
9. Advanced practical organic chemistry, J. Mohan, Vol. I and II, Himalaya Publishing House, 1992.
10. Practical organic chemistry (Quantitative analysis), B. B. Dey, M. V. Sitaraman and T. R. Govindachari, Allied Publishers, New Delhi, 1992.

VI SEMESTER BSc CHEMISTRY
PAPER VII: INORGANIC AND PHYSICAL CHEMISTRY
BSCCHCN601

Contact hours:56 **Work Load:4Hours/week** **Credit points:4**

Evaluation:Continuous Internal Assesment:40Marks
Semester End Examination: 60Marks

Course Objectives:

i) To make the students aware of the kinetics, stability, electronic spectra and types of bonding in complex compounds.
ii)To make the students understand the theories of binary mixtures and thermal methods of analysis of compounds.
iii)To make the students learn the potentiometric methods of quantitative analysis.

Course Specific outcomes:

After the completion of course, the students will

i) know the Kinetics of complex formation and also the electronic spectra of complexes which will help them in selecting the methods of synthesis and identification of complex compounds.
ii) understand the theories of bonding in complex compounds.
iii) understand the principle of steam distillation and separation of components of binary mixtures.
iv) get introduced to thermal methods of analysis.
v) understand the concept of galvanic cells and potentiometric methods of quantitative analysis.

UNIT – I

Metal-Ligand equilibria in solution: 10h

Step-wise and overall formation constant and their relationship, trends in step-wise constant, kinetic and thermodynamic stability of metal complexes, factors affecting the stability of metal complexes with reference to the nature of the metal ion and ligand, chelate effect, macrocyclic effect and their thermodynamic origin.

Electronic spectra of coordination compounds: 4h

Spectroscopic terms for ground states, selection rules, term symbols for d^n ions, Racah parameters, Orgel diagrams, spectra of 3d metal-aqua complexes of trivalent V, Cr, calculation of Dq, B and β parameters, CT spectra.

UNIT – II

Metal- ligand bonding: 12h

Stereoisomerism- coordination numbers 4 and 6. Crystal field theory, salient features, spectrochemical series, splitting of d-orbitals in tetragonal, square planar, trigonal bipyramidal and square-pyramidal geometry, applications of CFT- colours of transition metal complexes, magnetic properties of octahedral complex, distortion of octahedral complex, CFSE and their uses, factors affecting CFSE, limitations of CFT, experimental evidence for metal-ligand covalent bonding in complexes, nephelauxetic effect,

Magnetic properties of coordination compounds: 2h

Classification of magnetic materials, magnetic susceptibility, and its determination by Gouy method.

UNIT – III

Binary Mixtures 4h

Ideal liquid mixtures - Raoult's law, Vapour pressure vs composition (mole-fraction) curves. Azeotropes - HCl-H_2O and Ethanol-Water system; Fractional distillation, partially miscible liquids - phenol-water, triethylamine-water and nicotine-water systems. Lower and upper critical temperature; Effect of impurity on critical temperature. Immiscible liquids – steam distillation.

Phase Equilibrium 5h

Phase rule-Statement (mathematical expression) and meaning of the terms. Explanation for the terms phase, component and degrees of freedom with suitable examples for each. Derivation of phase rule from thermodynamic consideration. Explanation of phase equilibria of one component system (water and sulphur system) using phase diagram. Two component system - classification with examples, simple eutectic system (lead-silver system) - phase diagram and explanation, desilverisation of lead (Pattinson's Process). Compound formation with incongruent melting point (NaCl + water system) - phase diagram and explanation.

Thermo-analytical methods 5h

TGA - Principle, instrumentation, types of thermo balances; Deflection and null type; Factors affecting TGA curves – rate of heating and furnace atmosphere; Determination of composition of a compound with example of $CaC_2O_4.H_2O$. Applications – evaluation of suitable standard, testing of sample purity, study of organic compound, drying and ignition temperature, determination of curie point. DTG – Advantages over TGA; Significance of DTG curves. DTA - Principle, Factors affecting DTA curves – rate of heating and furnace atmosphere with example of $CaC_2O_4.H_2O$; Simultaneous TGA and DTA curves; interpretation of DTA curve.

UNIT – IV

Dilute Solutions and Colligative Properties: 6h

Ideal and non-ideal solutions - thermodynamic properties (ΔG, ΔH and ΔS) of ideal solutions, Activity and Activity coefficients, colligative properties – Definition and an elementary account of the four colligative properties. Raoult's Law of relative lowering of vapour pressure. Osmosis - Laws of osmotic pressure.

Elevation in boiling point and depression in freezing point. Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental determination of molecular weight by Walker-Lumsden method and Beckmann's method. Numerical Problems to be solved wherever necessary.

Electrochemistry: 8h

Galvanic cells. Reference electrodes, Calomel, Quinhydrone, Ag-AgCl and glass electrode (Construction, Electrode reaction, Nernst equation), E.M.F. of cells and its

measurements by potentiometric method, calculation of electrode potential, computation of cell EMF, relation between ΔG^0 and K for cell reaction, calculations.

Concentration cells: Electrolyte concentration cells with/without transport, liquid junction potential, calculations. Applications of concentration cells: Determination of a) valency of ions, b) solubility product

Application of E.M.F. measurements: a) Potentiometric titrations (acid- base and redox), b) Determination of p^H using hydrogen electrode, Quinhydrone electrode and Glass electrode by potentiometric methods.

Recommended Books/References:

1. Basic Inorganic Chemistry- F. A. Cotton, G. Wilkinson and P. L. Gaus; John Wiley and sons. Inc, 6thedition (1999).
2. Chemistry of elements- N. N. Greenwood and A. E. Earnshaw, Butterworth Heinemann (1997).
3. Inorganic Chemistry IV edition; J. E. Huheey, E. A. Keiter and R. L. Keiter, Addison; Wesley (1993).
4. Inorganic Chemistry, II edition, D. F. Shriver, P. W. Atkins and C. H. Langford, ELBS; Oxford UniversityPress, 1994.
5. Inorganic Electronic spectroscopy, A. B. P. Lever, Elsevier. (1968).
6. Magnetochemistry, R.L. Carlin, Springer Verlag.
7. Electronic Absorption Spectroscopy and related Techniques, D. N. Sathyanarayana, University Press(2001).
8. Inorganic Chemistry A Unified Approach by W. W. Porterfield, Elsevier 2005 2nd edition.
9. Textbook of inorganic chemistry by G. S. Sodhi, Viva books Pvt. Ltd (2011).
10. Molecular thermodynamics, Donald A. Mc Quarrie, John D. Simon University Science BooksCalifornia, (1999).
11. Thermodynamics for Chemists, by S. Glasstone, East-West Press, New Delhi, (1960).
12. Thermodynamics, by Rajaraman and Kuriacose, East-West Press, (1986).
13. Statistical Thermodynamics, M. C. Gupta (Wiley Eastern Ltd.) 1993.
14. Elementary Statistical Thermodynamics, N. D. Smith, Plenum Press, NY, (1982).
15. Elements of Classical and Statistical Thermodynamics, L. K. Nash, Addison-Wiley (1979).
16. Thermodynamics, Statistical Thermodynamics and Kinetics by Thomas Engel & Philip Reid, PearsonEducation inc. (2007)
17. Modern Electrochemistry Vol-1 and 2 J. O. M Bockris and A. K. N. Raddy, Plenum NewYork (1978)
18. An introduction to electrochemistry- Samuel Glastone East-West edition New Delhi (1942)
19. Text book of physical chemistry Samuel Glastone , 2nd edition, Mac Millan India Ltd (1991)
20. Electrochemistry, Principles and applications, Edmund, C. Potter, Cleaver-Hume press London(1961).
21. Principles and applications of Electrochemistry- D. R. Crow 3rd edition Chapmanhall London (1988).

Physical & Inorganic chemistry practical

PRACTICAL – VII

PHYSICAL & INORGANIC CHEMISTRY PRACTICAL

BSCCHPN601

Work Load: 4Hours/week **Credit points:2**

Evaluation: Continuous Internal Assesment: 25Marks
Semester End Examination: 25Marks

Course Objectives:

i) To introduce the students to gravimetric and volumetric methods analysis.
ii) To make students learn about physical properties of liquids.
iii) To make students learn some electrochemical methods of analysis.

Course Specific outcomes:

i) Students learn the application of gravimetry and volumetry in chemical analysis.
ii) Learn some of the instrumental and physical methods used in quantitative analysis.

PHYSICAL CHEMISTRY PRACTICAL

Chemical kinetics:

1. Study the hydrolysis of methyl acetate in presence of two different concentrations of HCl and report the relative strength.
2. Study the hydrolysis of methyl acetate in the presence of HCl at different temperatures and report the energy of activation.
3. Study of variation of viscosity of a liquid with temperature, determine the constant A and B.
4. Determination of pH of acetic acid -sodium acetate buffer by pHmetry.

Conductometric titration

1. Acid mixture versus NaOH.
2. Weak acid (CH_3COOH) with salt ($CuSO_4$) versus NaOH.
3. Strong acid (HCl) with salt (NH_4Cl) versus NaOH.

Potentiometric titration

1. $K_2Cr_2O_7$ versus FAS.
2. Weak acid versus NaOH

INORGANIC CHEMISTRY PRACTICAL

I-Gravimetric analysis

1.Gravimetric determination of Fe in iron ore as Fe_2O_3.

2.Gravimetric determination of Ni in Cu and Ni mixture.

3. Gravimetric estimation of Cu in Cu and Zn mixture.

II-Volumetric analysis

1.Volumetric estimation of Ca and Mg in Dolomite solution.

1. Volumetric estimation of Zn in Cu and Zn mixture.
2. Volumetric estimation of Ni in Ni and Zn mixture.

Recommended Books/References:

1. Vogel's text book of Quantitative Chemical Analysis, 5th Edition, J. Bassett, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).
2. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co., London (1972).
3. Findlays practical physical chemisty revised by P. B. Levitt, Longman's London (1966).
4. Experiments in Physical Chemistry by Shoemaker and Garland, McGraw Hill International Edn. (1966).
5. Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publications Meerut (1988).
6. Senior Practical Physical Chemistry by B. C. Kosla, Simla Printers New Delhi (1987).
7. Experimental Physical Chemistry by Daniel et al., McGraw Hill, New York (1962).
8. Practical Physical Chemistry by A.M James and P. E. Pritchard, Longman's Group Ltd (1968)
9. Experimental Physical Chemistry by Wilson, Newcombe & others, Pergamon Press, New York (1962).
10. Experimental Physical Chemistry by R. C. Behra and B Behra, Tata McGraw, New Delhi (1983).
11. Experimental Physical Chemistry by V. D. Atavale and Parul Mathur, New Age International, New York (2001).
12. Physical Chemistry Laboratory Principles and Experiments by H. W. Salberg J. I. Morrow,S. R. Cohen and M. E. Green Macmillan publishing Co .new York.
13. Practical's in physical chemistry A. Modern Approach by P.S Sindhu, Mac. Millan Publishers Delhi (2006).

PAPER VIII: ORGANIC CHEMISTRY AND SPECTROSCOPY
BSCCHCN602

Contact hours:56 **Work Load:4Hours/week** **Credit points:4**
Evaluation: Continuous Internal Assesment:40Marks
Semester End Examination: 60Marks

Course Objectives:

i)To understand the mechanism of electrophilic and nucleophilic substitution reactions and addition reactions with suitable examples.
ii) To learn the basics of symmetry and group theory.
iii) To learn PES and flame photometry.

Course Specific outcomes:

After the completion of the course, the students will
i) know the mechanism of selected electrophilic and nucleophilic substitution reactions
ii) understand the mechanism of addition reactions in organic compounds.
iii) get exposure to symmetry and group theory.
iv) get introduction to photo electron spectroscopy and flame photometry.

UNIT – I

Aromatic Substitution Reactions: 4h

Electrophilic Substitution Reactions: Sulfonylation reactions; Diazonium coupling, Vilsmeier-Haack reaction, Gatterman reaction.

Nucleophilic substitution reactions: 3h

Goldberg reaction, Bucherer reaction, Schiemann reaction.

Rearrangements: 3h

Wagner-Meerwein, Curtius, Lossen and Schmidt rearrangements. Benzil-benzilic acid rearrangement, Baeyer-Villiger oxidation.

Amino acids and Peptides: 4h

Synthesis and reactions of amino acids. Classification and nomenclature of peptides. Edmanmethods of sequencing. Cleavage of peptide bond by chemical and enzymatic methods. Protection of amino group and carboxyl group as alkyl and aryl esters. Coupling of protected amino acids.

UNIT - II

Addition Reactions: 14h

Addition to carbon-carbon multiple bonds: mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles, and free radicals. Regio, stereo- and chemoselectivities. Orientation and reactivity. Addition of halogens to alkenes-carbocation and halonium ion mechanisms. Stereo specificity of halogen addition. Addition to cyclopropane ring. Hydrogenation of double and triple bonds. Michael reaction.

Ozonolysis- Mechanism of ozonolysis of propene. Addition of hydrogen halides to alkenes- mechanism, regioselectivity and relative rates of addition. hydration, hydroxylation and epoxidation of alkenes-Explanation with examples. Electrophilic addition to conjugated dienes-effect of temperature. Free radical addition to 1,3-butadiene.

Addition to carbon-heteroatom multiple bonds: Addition of Grignard reagents and organolithium reagents to carbonyl compounds and unsaturated carbonyl compounds. Wittig, Mannich and Stobbe reactions.

UNIT – III

Symmetry and Group Theory in Chemistry: 6h

Definition of groups, subgroups, simple theorems in group theory. Symmetry elements and symmetry operations, point groups, Schöenflies notations, representations of groups by matrices, reducible and irreducible representations, character tables, Great Orthogonality Theorem (without proof) and its applications.

Photochemistry 8h

Interaction of radiation with matter, difference between thermal and photochemical processes. primary and secondary processes of a photochemical reaction, Laws of photochemistry: Grothuss - Draper law, Stark - Einstein law, (only statement) Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing). Quantum yield- definition, reasons for low and high quantum yield. Explanation for low and high quantum yield reactions taking combination of H_2 and Br_2 and combination of H_2 and Cl_2 as examples. Photosensitized reactions-energy transfer processes definition of photosensitization.(e.g.: Photosynthesis in plants, dissociation of H_2, Isomerization of 2-butene and butadiene).

UNIT – IV

Photoelectron Spectroscopy 3h

Principle, valence and core binding energies, shifts in energies due to chemical forces, photoelectron spectra of simple molecules.

Electron Paramagnetic Resonance Spectroscopy 8h

Electron Paramagnetic Resonance (EPR) Spectroscopy: Basic principles, selection rules, intensity, width, position of spectral line, multiplet structure of EPR spectra, hyperfine interaction, spin-orbit coupling, zero field splitting and Kramer's degeneracy, rules for interpreting spectra, factors affecting the magnitude of values. Instrumentation. Applications to the study of free radicals, coordination compounds.

Flame photometry 3h

General principles, Instrumentation, Interference and applications

Recommended Books/References:

1. Advanced Organic Chemistry - Reactions, Mechanism and Structure, Jerry March, John Wiley (2008).
2. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum (1990).
3. A Guide Book to Mechanism of Organic Chemistry, Peter Sykes, Longman (2000).
4. Structure and Mechanism of Organic Chemistry, C. K. Ingold, Cornell University Press.
5. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall (1998).
6. Modern Organic Reactions, H. O. House, Benjamin (1972).
7. Principles of Organic Synthesis, ROC Norman and J. M. Coxon, Blackie Academic and Professional(1996).
8. Stereochemistry of Organic Compounds, D. Nasipuri, New-Age International (1999).
9. Stereochemistry of Carbon Compounds, E. L. Eliel, S. H. Wilen and L. N. Mander, John Wiley (1994).

10. Organic Chemistry, Volumes I and II, I L Finar, Longman. (1999).
11. Medicinal Chemistry, A Kar, Wiley (2000).
12. Peptides Chemistry: A practical text book, M. Bodansky, Springer-Verlag NY, 1988.
13. Solid-phase peptide synthesis: A practical approach-E. Artherton & R.C. Sheppard, I R L, Oxford Univ. Press, 1989.
14. Peptides: Chemistry and Biology, N Selwad and H.-D. Jakubke, Wiley-VCH, 2002.
15. Chemical Applications of Group Theory, F. A. Cotton, Wiley Eastern (1976).
16. Molecular Symmetry, D. S. Schonland, Van Nostrand (1965).
17. Introduction to Molecular Spectroscopy, C. N. Banwell, TMH Edition (1994).
18. Introduction to Molecular Spectroscopy, G. M. Barrow, McGraw Hill (Int. Students Edition) (1988).
19. Molecular Spectroscopy, J. D. Graybeal, McGraw Hill (Int. Students Edition) (1990).
20. Spectroscopy, Vols. 1-3, B. P. Straughan and W. Walker, Chapman Hall (1976).
21. Physical Methods in Chemistry - R .S. Drago, Saunder college.
22. Structural Methods in Inorganic Chemistry - E. A. Ebsworth, D. W. H. Ranbin and S.Cradock, ELBS.
23. Spectra of Inorganic and Coordination Compounds - K. Nakamoto.
24. 10.Infrared Spectroscopy - C.N.R. Rao.
25. Introduction to Spectroscopy - D.L.Pavia, G.M.Lampman and G.S.Kriz, Thomson Learning, Singapore (2001)
26. Spectroscopic Identification of organic compounds - R. M. Silverstein and F. X. Webster, 6th Edition, Wiley and Sons, India Ltd. (2006).
27. Interpretation of Mass Spectroscopy-McLafferty.

PRACTICAL – VIII

ORGANIC CHEMISTRY PRACTICAL

BSCCHPN602

Work Load:4Hours/week **Credit points:2**
Evaluation:Continuous Internal Assesment:25Marks
Semester End Examination: 25Marks

Course Objectives:

i) To learn two and three stage synthesis of selected organic compounds.

ii) To learn the volumetric analysis of selected organic compounds.

Course Specific outcomes:

After the practical course, the students will know

i) two and three stage synthesis of selected organic compounds .

ii) how to analyse amino acids, phthalic acid, glucose and phenol volumetrically.

iii) to determine the saponification and iodine value of oils

Preparation (Two and three stages)

1. 2,4-Dinitrophenylhydrazine from chloronitrobenzene.
2. Anthranilic acid from phthalic acid.
3. Benzanilide from benzophenone.
4. Benzilic acid from benzoin.
5. Synthesis of Acridone.

Quantitative analysis

1.Titrimetric estimation of amino acids.
2.Saponification value of oil.
3.Estimation of glucose by Feighling's method.
4.Estimation of phenols.
5.Iodine value of oil (chloramine-T method).

Recommended Books/References:

1. Laboratory manual of Organic Chemistry- B. B. Dey, M V Sitaraman and T R Govindachari, Allied Publishers, NewDelhi, (1996).
2. Practical Organic Chemistry - Mann and Saunders, (1980).
3. Text Book of Practical Organic Chemistry- A. I. Vogel, (1996).
4. Test Book of Quantitative Organic Analysis- A. I. Vogel, (1996).
5. Comprehensive practical organic chemistry : Preparation and quantitative Analysis, V. K. Ahluwalia, R. Aggarwal, Universities Press (India), 2000.

6. An advanced course in practical chemistry, A. Ghoshal, B. Mahapatra and A. Kr. Nad, New central book agency, Calcutta, 2000.
7. Advanced practical organic chemistry, J. Mohan, Vol. I and II, Himalaya Publishing House, 1992.
8. Practical organic chemistry (Quantitative analysis), B. B. Dey, M. V. Sitaraman and T. R. Govindachari, Allied Publishers, New Delhi, 1992.