

# BABA FARID GROUP OF INSTITUTIONS



*“Chemistry is a part of everything in our surroundings. In the Chemistry program, you learn about how different types of matter are combined and what properties they possess. This could be, for example, the matter found in food or medicine. In the study of chemistry, you learn to describe the reactions, properties and combinations of matter we ourselves and our surroundings are made up of. This could mean anything from medicine, food, cleaning products and plastic toys, to the study of plants and animals. As a chemistry student, you will learn how to find answers to some of the questions and problems we run into every day. For example, how can we develop new and better medicines? Or, how can we develop new and better technologies for the production of food? Chemistry is a careers-orientated degree that opens up opportunities in high-technology industries and research, including pharmaceutical design, advanced materials, biochemical study and environmental protection.”*

--Dr. Mohd. Aslam  
H.O.D  
Department of Chemistry



M. Sc. Part – I (Semester – I)

CH – 101: Inorganic Chemistry – I

UNIT-I

Wave mechanics [15]

Origin of quantum theory, black body radiation, atomic spectra, photoelectric effect, matter waves, wave nature of the electron, the wave equation, the theory of

hydrogen atom, particle in one dimensional box, transformation of coordinates, Separation of variables and their significance.

UNIT-II

Stereochemistry and Bonding in main group compounds [15]

VSEPR theory & drawbacks,  $P_s - P_s$ ,  $P_s - d_s$  and  $d_s - d_s$  bonds, Bent rule, Hybridization involving f-orbital energies of hybridization, some simple reactions of covalently bonded molecules.

Unit-III [15]

a) Chemistry of transition elements (10)

General characteristic properties of transition elements, co-ordination chemistry of transition metal ions, stereochemistry of coordination compounds, ligand field theory, splitting of d orbitals in low symmetry environments, Jahn- Teller effect, Interpretation of electronic spectra including charge transfer spectra, spectrochemical series, nephelauxetic series, metal clusters, sandwich compounds, metal carbonyls

b) Bioinorganic Chemistry (05)

Role of metal ions in biological processes, structure and properties of metalloproteins in electron transport processes, cytochromes, ferredoxins and iron sulphur proteins, ion transport across membranes, Biological nitrogen fixation, PSI,

PS – II, Oxygen uptake proteins.

#### UNIT-IV

Electronic, Electric and Optical behaviour of Inorganic materials [15]

Metals, Insulators and Semiconductors, Electronic structure of solid, band theory, band structure of metals, insulators and semiconductors, Intrinsic and extrinsic semiconductors, doping of semiconductors and conduction mechanism, the band gap, temperature dependence of conductivity, carrier density and carrier mobility in semiconductors, synthesis and purification of semiconducting materials, single crystal growth, zone refining, fractional crystallization, semiconductor devices, rectifier transistors, optical devices, photoconductors, photovoltaic cells, solar batteries.

Recommended Books:

- 1) A. F. Wells, Structural Inorganic Chemistry – 5th edition (1984)
- 2) J H Huheey, Inorganic Chemistry - Principles, structure and reactivity, Harper and Row Publisher, Inc. New York (1972)
- 3) J. D. Lee, Concise Inorganic Chemistry, Elbs with Chapman and Hall, London
- 4) A. R. West, Plenum, Solid State Chemistry and its applications
- 5) N. B. Hanney, Solid State Physics
  
- 6) H. V. Keer, Principles of Solid State
- 7) S. O. Pillai, Solid State Physics
- 8) W. D. Callister, Wiley, Material Science and Engineering: An Introduction
- 9) R. Raghwan, First Course in Material Science
- 10) R. W. Cahan, The coming of Material Science
- 11) A. R. West, Basic Solid State Chemistry, 2nd edition
- 12) U. Schubert and N. Husing, Synthesis of Inorganic Materials, Wiley VCH (2000)
- 13) M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, Reinhold, EWAP
- 14) A. H. Hanney, Solid State Chemistry, A. H. Publications

- 15) O. A. Phiops, Metals and Metabolism
  - 16) Cullen Dolphin and James, Biological aspects of Inorganic Chemistry
  - 17) Williams, An Introduction to Bioinorganic Chemistry
  - 18) M. N. Hughes, Inorganic Chemistry of Biological Processes
  - 19) Ochi, Bioinorganic Chemistry
  - 20) John Wulff, The structure and properties of materials
  - 21) L. V. Azoroff, J. J. Brophy, Electronic processes in materials, Mc Craw Hill
  - 22) F. A. Cotton, R. G. Wilkinson. Advanced Inorganic chemistry
  - 23) Willam L. Jooly, Modern Inorganic Chemistry
  - 24) Manas Chanda, Atomic Structure and Chemical bonding
  - 25) N. N. Greenwood and A. Earnshaw, Chemistry of elements,. Pergamon
  - 26) Chakraborty, Solid State Chemistry, New Age International
  - 27) S. J. Lippard, J.M . Berg, Principles of bioinorganic Chemistry, University Science Books
  - 28) G. L. Eichhorn, Inorganic Biochemistry, Vol I and II, Elsevier
  - 29) Progress Inorganic chemistry , Vol 18 and 38, J. J. Lippard, Wiley
- Paper –CH-102: Organic Chemistry-1  
UNIT-I [15]

a) Reaction Mechanism: Structure and Reactivity (8)

Types of reactions, potential energy diagrams, transition states and intermediates.

Hard and soft acids and bases, strength of acids and bases. Generation, structure,

stability and reactivity of carbocations and carbanions.

b) Aliphatic Nucleophilic substitutions: (7)

The SN<sub>2</sub>, SN<sub>1</sub> and S<sub>N</sub>i reactions with respects to mechanism and stereochemistry.

Nucleophilic substitutions at an allylic, aliphatic trigonal and vinylic carbons.

Reactivity effect of substrate structure, effect of attacking nucleophiles, leaving

groups and reaction medium. Ambident nucleophiles, Neighbouring Group Participation.

#### UNIT-II [15]

##### a) Aromatic Electrophilic Substitutions: (8)

Introduction, Concept of Aromaticity, the arenium ion mechanism, orientation and reactivity in Nitration, Sulphonation, Friedel-Crafts and Halogenation in aromatic systems, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in their ring systems. Diazo-coupling, Vilsmeier reaction, Gatterman-Koch reaction, Von Richter rearrangement. Nucleophilic aromatic substitution reactions SN1, SN2.

#### UNIT-III [15]

##### a) Addition to Carbon–Carbon Multiple Bonds (7)

Mechanism and stereochemical aspects of the addition reactions involving electrophiles and free radicals, regio and chemo-selectivity, orientation and reactivity. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Michael reaction.

##### b) Elimination Reactions: (8)

The E1, E2 and E1cB mechanisms. Orientation in Elimination reactions. Reactivity: effects of substrate structures, attacking base the leaving group the nature of medium on elimination reactions. Pyrolytic elimination reactions.

#### UNIT-IV [15]

##### a) Study of following reactions: (7)

Beckmann, Fries, Benzilic acid, Hoffman, Schmidt, Curtius, Lossen & Benzilic acid, Wittig, Neber, and Prins.

##### b) Stereochemistry: (8)

Concept of Chirality and molecular dissymmetry, Recognition of symmetry elements and chiral centers, Prochiral relationship, homotopic, enantiotopic and diastereotopic groups and faces. Racemic modifications and their resolution, R and

S nomenclature. Geometrical isomerism E and Z. Nomenclature. Conformational analysis : cyclohexane derivatives, stability and reactivity, Conformational analysis of disubstituted cyclohexanes.

#### RECOMMENDED BOOKS

1. A guide book to mechanism in Organic chemistry (Orient-Longmens)- Peter Sykes
2. Organic reaction mechanism (Benjamin) R. Breslow
3. Mechanism and structure in Organic chemistry (Holt Reinh.)B. S. Gould.
4. Organic chemistry(McGraw-Hill)Hendrikson, Cram and Hammond.
5. Basic principles of Organic chemistry (Benjamin) J. D.Roberts and M. C. Caserio.
6. Reactive Intermediates in Organic chemistry (John Wiley)N. S. Issacs.
7. Stereochemistry of Carbon compounds. (McGraw-Hill)E.L.Eliel
8. Organic Stereochemistry (McGraw-Hill) by Hallas.
9. Organic reaction mechanism (McGraw-Hill) R. K. Bansal.
10. Organic chemistry- R. T. Morrison and R. N. Boyd,(Prentice Hall.)
11. Modern organic reactions(Benjumin) H. O. House.
12. Principle of organic synthesis- R.O.C. Norman and J. M. Coxon.(ELBS)
13. Reaction mechanism in organic chemistry- S. M. Mukharji and S. P. Singh.
14. Stereochemistry of organic compoundsc) D. Nasipuri.
15. Advanced organic chemistry (McGraw-Hill) J. March.
16. Introduction to stereochemistry(Benjumin) K. Mislow.
17. Stereochemistry by P. S. Kalsi (New Age International)

## Paper –CH-103: PHYSICAL CHEMISTRY – I

### UNIT-I

#### THERMODYNAMICS-I [15]

1. Introduction, revision of basic concepts. 03
2. Second law of thermodynamics: Physical significance of entropy (Direction of spontaneous change and dispersal of energy ), Carnot cycle, efficiency of heat engine, coefficient of performance of heat engine, refrigeration and problems. 06
3. Maxwell relations, thermodynamic equation of state, chemical potential, variation of chemical potential with temperature & pressure. Applications of chemical potential, phase rule, lowering of vapor pressure (Rault's law) and elevation in boiling point. 06

### UNIT-II

#### THERMODYNAMICS-II [15]

1. Ideal solutions, Rault's law, Duhem-Margules equation and its applications to vaporpressure curves( Binary liquid mixture ), determination of activity coefficients fromvapor pressure measurements, Henry's law. 08
2. Nonideal solutions : deviations from ideal behaviour of liquid mixtures, liquidvapor compositions, conditions for maximum. 07

### UNIT-III [15]

#### KINETIC THEORY OF GASSES

1. Postulates of kinetic theory of gases, P-V-T relations for an ideal gas, non-ideal behavior of gases, equation of state, compressibility factor, virial equation, van der Waal's equation, excluded volume and molecular diameter, relations of van der Waal's constants with virial coefficients and Boyle temperature. [05]
2. Molecular statistics, distribution of molecular states, deviations of Boltzmann

law for molecular distribution, translational partition function, Maxwell-Boltzmann law for distribution of molecular velocities, physical significance of the distribution law, deviation of expressions for average, root mean square and most probable velocities, experimental verification of the distribution law. [05]

3. Molecular collision in gases, mean free path, collision diameter and collision number in a gas and in a mixture of gases, kinetic theory of viscosity and diffusion. [05]

UNIT-IV [15]

#### COLLOIDS AND MACROMOLECULES

1. Sols, Lyophilic and lyophobic sols, properties of sols, coagulation. Sols of surface active reagents, surface tension and surfactants, critical micelle concentration. (05)

2. Macromolecules: Mechanism of polymerization, molecular weight of a polymer (Number and mass average ) viscosity average molecular weight, numerical problems. Degree of polymerization and molecular weight, methods of determining molecular

weights( Osmometry, viscometry, light scattering, diffusion and ultracentrifugation) 05

3. Chemistry of polymerization: Free radical polymerization(Initiation, propagation and termination ), kinetics of free radical polymerization, step growth polymerization( Polycondensation ), kinetics of step polymerization, cationic and anionic polymerization.( 05)

( More stress should be given to solving numerical problems )

#### RECOMMENDED BOOKS

1. Physical Chemistry – P. W. Atkins, Oxford University press, VIIth edition,2002.

2. Text book of Physical Chemistry – S. Glasstone

3. Principles of Physical Chemistry – Marron and Pruton



4. Physical Chemistry – G. M. Barrow, Tata-McGraw Hill, Vth edition, 2003.
5. Physical chemistry- G. K. Vemulapalli, Prentice-Hall of India, 1997.
5. Thermodynamics for Chemists – S. Glasstone, D. Van Nostrand , 1965.
6. Thermodynamics A Core Course- R. C. Srivastava, S. K. Saha and A. K. Jain, Prentice-Hall of India, IInd edition, 2004.
7. Physical Chemistry of macromolecules- D. D. Deshpande, Vishal Publications.
8. Polymer Chemistry- F. W. Billmeyer Jr, John-Wiley & Sons, 1971.

Paper CH-104 Analytical Chemistry –I

#### UNIT-I

Errors and treatment of Analytical Chemistry [15]

Errors, Determinant, constant and indeterminate. Accuracy and precision

Distribution of random errors. Average derivation and standard derivation,

variance and confidence limit. Significance figures and computation rules. Least square method. Methods of sampling: samples size. Techniques of sampling of gases, fluid, solids, and particulates.

#### UNIT-II

Chromatographic methods: [15]

General principle, classification of chromatographic methods. Nature of partition forces. Chromatographic behavior of solutes. Column efficiency and resolution.

Gas Chromatography: detector, optimization of experimental conditions. Ion exchanges chromatography. Thin layer chromatography: coating of materials, preparative TLC. Solvents used and methods of detection Column chromatography:

Adsorption and partition methods. Nature of column materials.

Preparation of the column. Solvent systems and detection methods.

#### UNIT-III

Electroanalytical Techniques: [15]

Polarography: Introduction, Instrumentation, Ilkovic equation and its verification.

Derivation of wave equation, Determination of half wave potential, qualitative and quantitative applications. Amperometry: Basic principals, instrumentation, nature of titration curves, and analytical applications.

#### UNIT-IV

Computer Science: [15

Introduction: History etc. Hardware: Central processor unit. Input devices. Storage

devices. Peripherals, Software: Overview of the key elements of basic program structure, loops, arrays, mathematical function. User defined functions, conditional

statements, string. Applications. Data representation, Computerized instruments system. Microcomputer interfacing

#### RECOMMENDED BOOKS

1. Analytical Chemistry: (J.W) G. D. Christain
  2. Introduction to chromatography : Bobbit
  3. Instrumental Methods of analysis (CBS)- H.H . Willard, L.L. Mirrit, J.A. Dean
  4. Instrumental Methods of Analysis : Chatwal and Anand
  5. Instrumental Methods of Inorganic Analysis(ELBS) : A.I. Vogel
  6. Chemical Instrumentation: A Systematic approach- H.A. Strobel
  7. The principals of ion-selective electrodes and membrane transport: W.E.Morf
  8. Physical Chemistry – P.W.Atkins
  9. Principal of Instrumental Analysis- D. Skoog and D.West
  10. Treatise on Analytical Chemistry: Vol I to VII – I.M. Kolthoff
  11. Computer, Fundamentals-P.K.Sinha
  12. Programming in BASIC : E. Balaguruswamy
  13. Computer programming made simples : J.Maynard.
- M. Sc. Part I Inorganic Chemistry Practical Course  
(Practical no. 111 and 112)

1. Ore analysis – '2' ores
2. Alloy analysis – '2' (Two and three components)
3. Inorganic Preparations and purity – '4'

References:

- 1) A text book of Quantitative Inorganic Analysis – A. I. Vogel
- 2) Experimental Inorganic Chemistry - W. G. Palmer
- 3) The analysis of minerals and ores of the rarer elements – W. R. Schoeller and A.R. Powell, Charles, Griffin and Company Limited

SEMISTER-I

ORGANIC CHEMISTRY PRACTICALS

A) Preparations

(One stage preparations involving various types of reactions)

1. Oxidation: Adipic acid by chromic acid oxidation of Cyclohexanol.
2. Aldol condensation: Dibenzal acetone from Benzaldehyde.
3. Sandmeyer reaction: p- Chlorotoulene from p-Toluidine.
4. Cannizzaro reaction: 4-chlorobenzyldehyde as a substrate.
5. Aromatic Electrophilic substitutions: Synthesis of p-Nitroaniline and p-Bromoaniline.
6. Preparation of Cinnamic acid by Perkin's reaction.
7. Knoevenagel condensation reaction
8. Coumarin Synthesis
9. Synthesis of Heterocyclic compounds.
10. Synthesis of Dyes

B) Estimations:

1. Estimation of unsaturation.
2. Estimation of formalin.
3. Colorimetric Estimation of Dyes
4. Estimation of Amino acids

(Any suitable Expt. may be added.)

## REFERENCE BOOKS

1. A text book of practical organic chemistry- A. I. Vogel.
2. Practical organic chemistry- Mann and Saunders.
3. A handbook of quantitative and qualitative analysis- H. T. Clarke.
4. Organic Synthesis Collective Volumes by Blat.

M.Sc I – Semester I

Physical Chemistry Practicals

Students are expected to perform 15-20 experiments of three and half hours duration.

Experiments are to be set up in the following techniques.

### 1. Potentiometry:

Determination of solubility and solubility product of silver halides, determination of binary mixture of weak and strong acid etc.

### 2. Conductometry :

Determination of mixture of acids and relative strength of weak acids.

### 3 Refractometry :

Determination of molecular radius of molecule of organic compound.

### 4 Polarimetry :

Kinetics of inversion of cane sugar in presence of strong acid.

### 5 Chemical Kinetics :

Kinetics of reaction between bromate and iodide.

### 6 Partial Molar Volume :

Determination of PMV by intercept method, density measurements etc.

( New experiments may also be added )

Books recommended for Practicals :

- 1 Findlay's Practical Chemistry – Revised by J.A. Kitchner (Vedition)
- 2 Text Book of Quantitative inorganic analysis : A.I. Vogel.
- 3 Experimental Physical Chemistry : R.C.Das and B. Behera

- 4 Practical Physical Chemistry : B. Viswanathan and P.S. Raghavan
- 5 Experimental Physical Chemistry :V.D. Athawale and Parul Mathur.
- 6 Systematic Experimental Physical Chemistry :S.W. Rajbhoj and T.K.

Chondhekar

M. Sc. Part-I Semester-I

Practicals in Analytical Chemistry.

#### Physical Chemistry Section

- 1) To verify Beer-Lambert's Law for potassium permanganate solution and hence to determine the molar extinction coefficient and unknown concentration of given sample colorimetrically
- 2) To determine the solubility of calcium oxalate in presence of KCl ( Ionic Strength Effect)
- 3) To determine the solubility of calcium oxalate in presence of HCl ( H<sup>+</sup> ion Effect)

(Any other experiments may be added)

#### Organic Chemistry Section

- 1 Analysis of Pharmaceutical tablets.
- 2 To verify the Beer-Lamberts Law and determine the concentration of given dye solution colorimetrically.
- 3 To estimate the amount of D-glucose in given solution colorimetrically.
- 4 To determine the acid value of given oil

(Any other experiments may be added)

#### Inorganic Chemistry Section

- 1 Determination of sodium from the fertilizer sample using cation exchange chromatographically.

- 2 Determination of calcium from given drug sample.
  - 3 Determination of hardness, alkalinity and salinity of water sample
  - 4 Separation and estimation of chloride and bromide on anion exchanger.
- (Any other experiments may be added)

## M. Sc. Part – I (Semester – II)

### CH 201: Inorganic Chemistry – II

#### UNIT-I [15]

Chemistry of non – Transition elements

General discussion on the properties of the non – transition elements, special features of individual elements, synthesis, properties and structure of halides and oxides of the non – transition elements, Polymorphism in carbon, phosphorous and

sulphur, Synthesis, properties and structure of boranes, carboranes, silicates, carbides, phosphazenes, sulphur – nitrogen compounds, peroxo compounds of boron, carbon, sulphur, structure and bonding in oxyacids of nitrogen, phosphorous, sulphur and halogens, interhalogens, pseudohalides.

#### UNIT-II

##### a) Organometallic Chemistry of transition elements [08]

Ligand hapticity, electron count for different types of organometallic compounds, 18 and 16 electron rule exceptions, synthesis, structure and bonding, organometallic reagents in organic synthesis and in homogeneous catalytic reactions (Hydrogenation, hydroformylation, isomerisation and polymerisation), pi metal complexes, activation of small molecules by coordination

##### b) Metal – ligand equilibria in solution [ 07]

Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of formation constants by pH – metry, spectrophotometry methods.

#### UNIT-III

Studies and applications of Lanthanides and Actinides [15]

Spectral and magnetic properties, use of lanthanide compounds as shift reagents,

Modern methods of separation of lanthanides and actinides, Organometallic chemistry applications of lanthanide and actinide compounds in Industries.

#### UNIT-IV

a) Chemistry in Non- aqueous solvents [07]

Classification of solvents, properties, leveling effect, type reactions in solvents, chemistry of liquid ammonia, liquid dinitrogen tetroxide and anhydrous sulphuric acid with respect to properties, solubilities and reactions.

b) Nuclear and radiochemistry [08]

Radioactive decay and equilibrium, nuclear reactions, Q value, cross-sections, types of reactions, chemical effects of nuclear transformation, fission and fusion, fission products and fission yield

Recommended Books:

- 1) A. F. Wells, Structural Inorganic Chemistry – 5th edition (1984)
- 2) J H Huheey, Inorganic Chemistry - Principles, structure and reactivity, Harper and Row Publisher, Inc. New York (1972)
- 3) J. D. Lee, Concise inorganic Chemistry, Elbs with Chapman and Hall, London
- 4) M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, Reinhold, EWAP
- 5) Jones , Elementary coordination Chemistry
- 6) Martell, Coordination Chemistry
- 7) T. S. Swain and D. S. T. Black, organometallic Chemistry
- 8) John Wulff, structure and properties of materials, vol – 4, electronic properties, Wiley Eastern
- 9) L. V. Azoroff, J. J. Brophy, Electronic processes in materials, Mc Craw Hill
- 10) F. A. Cotton, R. G. Wilkinson. Advanced Inorganic chemistry
- 11) Willam L. Jooly, Modern Inorganic Chemistry

- 12) Manas Chanda, Atomic Structure and Chemical bonding
  - 13) P. L. Pauson, Organometallic Chemistry
  - 14) H. S. Sisler, Chemistry in non – aqueous solvents, Reinhold Publishing Corporation, USA, 4th edition (1965)
  - 15) H. J. Arnikar, Essentials of Nuclear Chemistry
  - 16) Friedlander, Kennedy and Miller, Nuclear and Radiochemistry
- Paper-CH-202: Organic Chemistry-II  
UNIT-I

Study of following reactions: [15]

Mechanism of condensation reaction involving enolates Mannich, Benzoin, Stobbe, Dieckmann, Diels-Alder, Robinson annulation Reimer-Tieman, Chichibabin, Baeyer Villiger oxidation

UNIT-II [15]

a) Alkylation and Acylation

Introduction, Types of alkylation and alkylating agents: C-Alkylation and Acylation of active methylene compounds and Applications. (8)

b) Hydroboration and Enamines : Mechanism and Synthetic Applications. (7)

UNIT-III [15]

a) Reductions: (08)

Study of following reductions- Catalytic hydrogenation using homogeneous and heterogeneous catalysts. Study of following reactions: Wolff-Kishner, Birch, Clemmensen, Sodium borohydride, Lithium Aluminium hydride (LAH) and Sodium in alcohol, Fe in HCl.

b) Oxidation : (07)

Application of following oxidizing agents:  $\text{KMnO}_4$ , chromium trioxide, Manganese dioxide, Osmium tetroxide, DDQ, Chloranil .

UNIT-IV [15]

a) Study of Organometallic compounds: (08)



Organo-magnesium, Organo-zinc and Organo-lithium, Hg and Sn reagents; Use of

lithium dialkyl cuprate their addition to carbonyl and unsaturated carbonyl compounds.

b). Methodologies in organic synthesis -ideas of syntheses and retros.

Functional

group transformations and interconversions of simple functionalities. (07)

#### RECOMMENDED BOOKS

1. Modern synthetic reactions-(Benjamin) H. O. House.
2. Reagents in organic synthesis-(John Wiley) Fieser and Fieser
3. Principles of organic synthesis-(Methuen) R. O. C. Norman
4. Hydroboration- S. C. Brown.
5. Advances in Organometallic Chemistry- (A.P.)F. C. A. Stone and R. West.
6. Organic Chemistry (Longman)Vol. I & Vol. II- Finar
7. Oxidation by-(Marcel Dekker) Augustin
8. Advanced Organic chemistry 2nd Ed. R R. Carey and R. J. Sundburg.
9. Tetrahedron reports in organic chemistry- Vol. 1, No. 8.
10. Organic Synthesis-(Prentice Hall)R. E. Ireland.
11. Homogeneous Hydrogenation-(J. K.) B. R. James.
12. Comprehensive Organic Chemistry- (Pargamon) Barton and Ollis.
13. Organic reactions- various volumes- R. Adams.
14. Some modern methods of Organic synthesis-(Cambridge) W. Carruthers.

Paper-CH-203: PHYSICAL CHEMISTRY – II

UNIT-I

#### PHOTOCHEMISTRY [15]

Absorption of light and nature of electronic spectra, electronic transition, Frank-Condon principle, selection rules, photodissociation, predissociation, photochemical reactions: photoreduction, photooxidation, photodimerization,

photochemical substitution, photoisomerization, photochemistry of environment:  
Green house effect.

#### UNIT-II [15]

Photo physical phenomena: Electronic structure of molecules, molecular orbital, electronically excited singlet states, designation based on multiplicity rule, life time of electronically excited state, construction of Jablonski diagram, electronic transitions and intensity of absorption bands, photophysical pathways of excited molecular system( radiative and non-radiative ), prompt fluorescence, delayed fluorescence, and phosphorescence, fluorescence quenching: concentration quenching, quenching by excimer and exciplex emission, fluorescence resonance

energy transfer between photexcited donor and acceptor systems. Stern-Volmer relation, critical energy transfer distances, energy transfer efficiency, examples and analytical significance, bimolecular collisional V quenching and Stern-Volmer equation.

#### UNIT-III. [15]

##### ELECTROCHEMISTRY

1. Arrhenius theory of electrolytic dissociation (Evidences and limitations), revision of basic electrochemistry( Types of electrodes and cells). (03)
2. Electrochemical cells with and without transference, determination of activity coefficients of an electrolyte, degree of dissociation of monobasic weak acid (approximate and accurate ), instability constant of silver ammonia complex. (10)
3. Acid and alkaline storage batteries. 02

#### UNIT-IV [15]

##### CHEMICAL KINETICS

Experimental methods of following kinetics of a reaction, chemical and physical (measurement of pressure, volume, EMF, conductance, diffusion current and absorbance) methods and examples. Order and methods of determination( Initial

rate, Integration, graphical and half life methods), rate determining step, steady state approximation and study of reaction between NO<sub>2</sub> and F<sub>2</sub>, decomposition of

ozone, and nitrogen pentoxide. 08

2. Kinetics of complex reactions, Simultaneous (first order opposed by first order),

Parallel and Consecutive reactions. Examples and numericals. 07

### RECOMMENDED BOOKS

1. Photochemistry – J. G. Calverts and J. N. Pitts, John-Wiley & Sons

2. Fundamentals of Photochemistry- K. K. Rohatgi-Mukharjii, Wiley Eastern

3. Introduction to Photochemistry-Wells

4. Photochemistry of solutions-C. A. Parker, Elsevier

5. Chemical Kinetics-K. J. Laidler, pearson Education,2004

6. Electrochemistry- S. Glasstone, D. Van Nostrand , 1965

7. Advanced Physical Chemistry- Gurdeep Raj, Goel Publishing House

8. Basic chemical Kinetics- G. L. Agarwal, Tata-McGraw Hill

9. Physical Chemistry – P. W. Atkins, Oxford University press, VIIth edition,2002.

10. Physical Chemistry – G. M. Barrow, Tata-McGraw Hill, Vth edition, 2003.

Paper CH-204 Analytical Chemistry- II  
UNIT-I [15]

a) Ultraviolet and visible spectrophotometry (UV-VIS) (08)

Introduction, Beer Lambert's law, instrumentation, calculation of absorption maxima of dienes, dienones and polyenes, applications.

b) Infrared Spectroscopy (IR) (07)

Introduction, instrumentation, sampling technique, selection rules, types of bonds,

absorption of common functional groups. Factors affecting frequencies,

applications.

## UNIT-II [15]

### a) Nuclear Magnetic Resonance (NMR) 8

Magnetic and non magnetic nuclei, Larmor frequency, absorption of radio frequency. Instrumentation (FT-NMR). Sample preparation, chemical shift, anisotropic effect, spin-spin coupling, coupling constant, applications to simple structural problems

### b) Mass spectroscopy (MS) 7

Principle, working of mass spectrometer (double beam). Formation of different types of ions, McLafferty rearrangements, fragmentation of alkanes, alkyl aromatics, alcohols and ketones, simple applications, simple structural problems based on IR, UV, NMR and MS

## UNIT-III

### a) Nephelometry and Turbidometry (07)

Introduction, Theory, Instruments, working and Applications

### b) Radiochemical Analysis, NAA: Scintillation counter and G.M. Counter (08)

## UNIT-IV

### a) Atomic Absorption Spectroscopy (10)

Introduction, Principle, difference between AAS and FES, Advantages of AAS over FES, advantages and disadvantages of AAS. Instrumentation, Single and double beam AAS, detection limit and sensitivity, Interferences applications.

### b) Inductively coupled Plasma Spectroscopy (5)

Introduction, Nebulisation Torch, Plasma, Instrumentation, Interferences, Applications

## REFERENCE BOOKS

1. Instrumental Methods of analysis- Willard, Merrit, Dean and Settle.
2. Spectroscopic identification of organic compounds- R.M. Silverstein and G.C.

Bassler

3. Spectroscopic methods in organic chemistry- D.H. Williams and I. Fleming
4. Absorption spectroscopy of organic molecules- V.M. Parikh
5. Applications of spectroscopic techniques in Organic chemistry- P.S. Kalsi
6. A Text book of Qualitative Inorganic Analysis- A. I. Vogel
7. Physical Methods in Inorganic Chemistry (DWAP)- R. Drago
8. Fundamentals of Analytical Chemistry – D.A. Skoog and D.M. West (Holt

Rinehart and Winston Inc )

M. Sc. Part – I (Semester - II)

CH – 201: Inorganic Chemistry Practical Course  
(Practical no. 211 and 212)

1. Ore analysis – ‘2’ ores
2. Alloy analysis – ‘2’ (Two and three components)
3. Inorganic Preparations and purity – ‘4’

References:

- 1) A text book of Quantitative Inorganic Analysis – A. I. Vogel
- 2) Experimental Inorganic Chemistry - W. G. Palmer
- 3) The analysis of minerals and ores of the rarer elements – W. R. Schoeller and A. R. Powell, Charles, Griffin and Company Limited

SEM-II

ORGANIC CHEMISTRY PRACTICLES

1. Qualitative analysis:

Separation and identification of the two component mixtures using  
Chemical and physical methods.

2. Thin layer chromatography (TLC).

3. Column chromatography and steam distillation techniques.

4. Determination of percentage of Keto-enol form.

5. Estimation of pesticides

(Any other suitable experiments may be added).

## REFERENCE BOOKS

1. A text book of practical organic chemistry- A. I. Vogel.
2. Practical organic chemistry- Mann and Saunders.
3. A handbook of quantitative and qualitative analysis- H. T. Clarke.
4. Organic Synthesis Collective Volumes by Blat.

M.Sc I – Semester II

### Physical Chemistry Practicals

Students are expected to perform 15-20 experiments of three and half-hours duration.

Experiments are to be set up in the following techniques.

#### 1 Potentiometry:

Determination formal redox potential of system, determination of binary mixture of halides.

#### 2. Conductometry :

Titration of ternary acid mixture of acids, Verification of Onsagar Equation for 1:1 type strong electrolyte.

#### 3 Refractometry :

Determination of atomic refractions of H, C and Cl atoms.

#### 4 Cryoscopy:

Determination of apparent weight and degree of dissociation a strong electrolyte equilibrium methods.

#### 5 Chemical kinetics:

Kinetics of iodination of acetone in presence of strong acid etc.

#### 6 Phase Equilibrium:

Three component system etc.

(New experiments may be also be added)

Books recommended for Practicals :

1. Findlay's Practical Chemistry – Revised by J.A. Kitchner (Vedition)

2. Text Book of Quantitative inorganic analysis : A.I. Vogel.
3. Experimental Physical Chemistry : By F. Daniels and J. Williams
4. Experimental Physical Chemistry : R.C Das and B.Behera
- 5 Practical Physical Chemistry : B. Viswanathan and P.S. Raghavan

M. Sc. Part-I Semester-II

Practicals in Analytical Chemistry.

Physical Chemistry Section

- 1 To estimate the amount of  $\text{NH}_4\text{Cl}$  colorimetrically using Nessler's Reagent.
- 2 Determine the solubility of lead iodide in presence of varying concentration of salt  
KCl.
- 3 Determine the solubility of lead iodide in presence of varying concentration of salt  
KNO<sub>3</sub>

(Any other experiments may be added)

Organic Chemistry Section

- 1 Analysis of pharmaceutical tablets: Ibrufen / INAH
- 2 Colorimetric estimation of drugs.
- 3 Preparation of pesticides.
- 4 Column and thin layer chromatography

(Any other experiments may be added)

Inorganic Chemistry Section

- 1 To determine the amount of copper in brass metal alloy colorimetrically.
- 2 Separation and estimation of Copper and Cobalt on cellulose Column.
- 4 Separation and estimation of Nickel and Cobalt on a anion exchanger.
- 5 Separation and estimation of Iron and aluminium on a cation exchanger.

(Any other experiments may be added)

Recommended books

- 1 A Text book of quantitative Inorganic Analysis – A.I.Vogel
- 2 Standards methods of Chemical Analysis-F.J. Welcher.
- 3 Experimental Inorganic Chemistry – W.G.Palmer.
- 4 Manual on Water and Waste Water Analysis, NEERI- Nagpur D.S. Ramteke and C.A.Moghe
- 5 Inorganic synthesis- King.
- 6 Synthetic Inorganic Chemistry-W.L.Jolly
- 7 EDTA Titrations –F.Laschka

M. Sc. Part-I Semester-II

Practicals in Analytical Chemistry.

Physical Chemistry Section

- 6 To estimate the amount of  $\text{NH}_4\text{Cl}$  colorimetrically using Nessler's Reagent.
- 7 Determine the solubility of lead iodide in presence of varying concentration of salt KCl.
- 8 Determine the solubility of lead iodide in presence of varying concentration of salt  $\text{KNO}_3$  (Any other experiments may be added)

Organic Chemistry Section

- 5 Analysis of pharmaceutical tablets: Ibrufen / INAH
- 6 Colorimetric estimation of drugs.
- 7 Preparation of pesticides.
- 8 Column and thin layer chromatography  
(Any other experiments may be added)

Inorganic Chemistry Section

- 2 To determine the amount of copper in brass metal alloy colorimetrically.
- 2 Separation and estimation of Copper and Cobalt on cellulose Column.
- 9 Separation and estimation of Nickel and Cobalt on a anion exchanger.
- 10 Separation and estimation of Iron and aluminium on a cation exchanger.  
(Any other experiments may be added)

Recommended books

- 8 A Text book of quantitative Inorganic Analysis – A.I.Vogel



9 Standards methods of Chemical Analysis-F.J. Welcher.

10 Experimental Inorganic Chemistry – W.G.Palmer.

11 Manual on Water and Waste Water Analysis, NEERI- Nagpur D.S. Ramteke and C.A.Moghe

12 Inorganic synthesis- King.

13 Synthetic Inorganic Chemistry-W.L.Jolly

14 EDTA Titrations –F.Laschka

M.Sc-II

INORGANIC

Paper No-ICH-301, INORGANIC CHEMICAL SPECTROSCOPY

Unit-I

Group Theory [15]

Molecular symmetry, elements of symmetry and symmetry operations, Products of operation, point group, classification of Molecules into point group, reducible and irreducible representation, the great Orthogonality theorem, character table, symmetry aspects of Molecular orbitals.

Unit-II

Electronic absorption Spectroscopy [15]

Term symbols, energies of atomic and Molecular transitions, Selection rule, Morse potential energy diagram, electronic transitions, polarized absorption spectra. Nature of absorption spectra, nature of absorption spectra of transition metal complexes, Orgel diagram, Tanabe Sugano diagram, charge transfer spectra.

Unit-III [15]

A) Infrared and Raman Spectroscopy [9]

Molecular vibrations, force constants, Molecular vibrations and absorption of Infrared radiations Raman Spectroscopy, polarized Raman lines, Use of symmetry considerations

to determine the no. of lines in IR and Raman Spectra, Spectra of gases, applications of Raman and Infrared spectroscopy. Selection rule in Inorganic structure determinations, Hydrogen bonding and infrared spectra, metal ligand and related vibrations.

B) Microwave spectroscopy [6]

Basic concept, rotation spectra of simple inorganic compounds, Classification of

molecules, rigid rotor model, effect of isotopic substitution on transition frequencies & intensities non rigid rotor, Stark effect nuclear and electron spin interaction and effect of external field. Applications of Micro wave Spectroscopy.

#### Unit-IV [15]

##### A] Nuclear Magnetic Resonance Spectroscopy [8]

Principle Instrumentation of NMR, the chemical shift, mechanism of electron shielding and factors contributing to the magnitude of chemical shift. Local & remote effect, spin-spin

splitting, applications of spin coupling to structural determination, double Resonance techniques. The contact and Pseudo contact shifts Factors affecting nuclear relaxation, an

overview of NMR of metal nuclear with emphasis on  $^{195}\text{Pt}$  &  $^{119}\text{Sn}$  NMR.

##### B] Electron & Photo acoustic Spectroscopy [7]

Introduction, principle, Instrumentation and applications of following techniques photo acoustic Spectroscopy (PAS) photo electron Spectroscopy (PES), Auger electron Spectroscopy (AES)

Recommended books:

1. K. Burger, Coordination Chemistry-experimental methods, Butterworth's
2. R. Drago: Physical method in Inorganic Chemistry, DUSAP.
3. Hill & Day advanced methods in Inorganic Chemistry, J. Wiley
4. F.A. Cotton, chemical application of group theory, Wiley eastern
5. Figgis, Introduction to ligand field theory field
6. Schaefer & Gilman: Basic principles of ligand field Theory, J. Wiley
7. P.R. Backer: Molecular symmetry and Spectroscopy A.P.
8. Ferraro Ziomek, Introduction to Group theory, Plenum
9. Sotland Molecular symmetry DVN
10. Dorian: symmetry in Chemistry EWAP
11. Hall: Group theory and symmetry in Chemistry MGLt
12. Nakamoto Infrared R Raman Spectra of Inorganic & Coordination compounds J. Wiley
13. Nakanishi: Spectroscopy and structure J. Wiley
14. Ferraro: Metal ligand and related vibrations

15. CNR Rao Spectroscopy in Inorganic Chemistry Vol I,II,III
16. Durie: vibrations spectra and structure Vol. I to IV, Elsevier
17. Dudd, chemical Spectroscopy Elsevier
18. Popel : H.N.M.R. Spectroscopy J.Weily
19. R.J. Abraham, J.Fisher and P Loftus Wiley Introduction to NMR spectroscopy.
20. P.K. Bhattacharya: Group Theory & Its Chemical Applications
21. K.V. Reddy: Symmetry & spectroscopy of Molecules.

## Paper No. ICH-302 COORDINATION CHEMISTRY – I

### UNIT-I

Theories of Metal-Ligand bonding [15]

Molecular Orbital treatment, Octahedral (with and without pi bonding) tetrahedral and square planer complexes in a qualitative manner, comparison of theories of bonding, VBT, CFT, LFT and MOT.

### UNIT-II

Structural studies of coordination compounds [15]

Compounds of first transition series elements, with respect to their electronic spectra, magnetic & thermal properties (DTA, TGA)

### UNIT-III

Magneto Chemistry [15]

Diamagnetic correction, single & multielectron system, types of the magnetic behaviour, Diamagnetism, Para magnetism, Ferro & Ferri, Antiferro and magnetic interaction, The origin of Para magnetism, Magnetic behavior of complexes, Simplification of Van Velck equation, magnitude of magnetic moments, Determination of magnetic susceptibility by Gouy and faraday method.

### UNIT-IV [15]

A] Transition metal complexes & catalysis [8]

Introduction, General Principle, catalysis by transition metal complexes, Hydrocarbons

Oxidation by Molecular oxygen, olefin Oxidation, olefin polymerization, olefin

hydrogenation, Arene reactions catalyzed by metal complexes, catalysis of condensation

polymerization reaction, Current and feature trend in catalysis.

B] Mixed Ligand complexes [7]

Stabilities of ternary complexes, Dynamics of formation of ternary complexes reaction of

Coordination ligand in ternary complexes, Mimicking reactions in biological systems, enzyme models, Amino acids ester hydrolysis, peptide synthesis & hydrolysis, Detarbodylation of B keto acids

Recommended Books.

1. Jones: Elementary Coordination Chemistry. J. Wiley
2. Graddon: Introduction to Coordination Chemistry. J. Wiley
3. Drago: Physical methods of Inorganic Chemistry. J. Wiley.
4. Graddon: Introduction to coordination Chemistry, Parasmom
5. Lewis and Wilkins: Coordination Chemistry. J. Wiley
6. Msrtel: Coordination Chemistry Vol I, II VNR
7. Earnshaw: Introduction to Magneto Chemistry
8. Mabbs & Machin Magnetism & transition metal complexes Chamman hall
9. Calvin, Magnetic properties of transition metal complexes.
10. L.N. Maley: Magneto Chemistry
11. Datta & Shymal Elements of Magneto Chemistry
12. Martel & Taqui Khan: homogeneous catalysis with metal complexes Vol.I & II AP.
13. James E. Huheey: Inorganic Chemistry Principles of Structure and reactivity, Harber & Row, Publishers Inc. New York 1972.
14. K.P. Purcell & J.C. Kote: An Introduction to Inorganic Chemistry Holt Sounders, Japan 1980.
15. William L. Jolly: Modern Inorganic Chemistry, Mecgrow Hill USA, 1984
16. F.A. Cotton & R.G. Wilkinson: Advanced Inorganic Chemistry.

## Paper No. ICH 303 NUCLEAR CHEMISTRY

### UNIT-I

Systematic of alpha, beta and gamma decays [15]

Alpha decay, energy curve, spectra of alpha particles, Giger-Nuttal law, theory of alpha decay, penetration of potential barrier, beta decay, range of energy relationship, beta spectrum, sergeants curve, Fermi theory of beta decay, matrix elements, allowed and forbidden transitions, curie plots, gamma decay, Nuclear energy levels, selection rule, isomeric transitions, Internal conversion, Auger effect.

### UNIT-II

## Nuclear Structure and Stability [15]

Binding energy, empirical mass equation, The nuclear models, the liquid drop model, the

shell model, the Fermi gas model & collective nuclear model, nuclear spin, parity & magnetic moments of odd mass numbers nuclei.

## UNIT-III [15]

### A] Nuclear reaction. [8]

Introduction, Production of projectiles, nuclear cross section, nuclear dynamics, threshold

energy of nuclear reaction, Coulomb scattering, potential barrier, potential well, formation of a compound nucleus, Nuclear reactions, direct Nuclear reactions, heavy ion

induced nuclear reactions, photonuclear reactions.

### B] Nuclear fission [7]

Liquid drop model of fission, fission barrier and threshold, fission cross section, mass energy and charge distribution of fission products, symmetric and A symmetric fission, decay chains and delayed neutrons.

## UNIT-IV [15]

### A] Reactor Theory - [10]

Nuclear fission as a source of energy, Nuclear chain reacting systems, critical size of a reaction, research reactors, graphite moderated, heterogeneous, enriched uranium reactors, light water moderated, heterogeneous, enriched uranium reactors, water boilers

enriched aq. Homogeneous reactors, Thermonuclear reactors, gamma interactions, shielding and health protection. Reactors in India.

### B] Nuclear Resources in India [5]

Uranium and Thorium resources in India and their extractions, Heavy water manufacturing in India.

Reference Books.

1. Friedlander, Kennedy and Miller, Nuclear and Radio Chemistry: John Wiley
2. B.G. Harvey, Nuclear Chemistry
3. Hassinsky: Translated by D.G. Tuck, Nuclear Chemistry and its application: Addison Wiley

4. B.G. Harvey, Introduction to Nuclear Physics and Chemistry
5. Maeclefort: Nuclear Chemistry: D.Van Nostrand
6. An N.Nesmeyannoy: Radiochemistry: Mir
7. Jacobs et al: Basic Principles of nuclear Science and Reactors, V.Nost & EWAP
8. N.Jay: Nuclear Power Today Tomorrow: ELBS
9. Kenneth: Nuclear Power Today, Tomorrow: ELBS
10. Essentials of Nuclear Chemistry, W.J. Arnikar, John Wiley
11. Nuclear and Radiation Chemistry: B.K. Sharma, Krishna Publication
12. A Introduction to Nuclear Physics: R. Babber. And Puri

## Paper ICH 304A ENVIRONMENTAL CHEMISTRY

### UNIT-I [15]

#### A] Air Pollution [8]

Sources and sinks of gases pollutants, classification & effects of air pollutants on living and nonliving things, Air pollution problems in India, pollution problems in industrial area, global air pollution problems, green house effect, acid rain, ozone depletion and their consequences on Environment. Major air pollution disasters.

#### B] Water pollution [7]

Types, sources and classification of water pollutants, Industrial water pollution, constituents of aquatic Environment, oxygen contents of water and aquatic life, oxygen electrode, and its use, mercury pollution and estimation of organomercurials, industrial water, Effects of water pollutants on life and Environment.

### UNIT-II [15]

#### A] Method of control of air pollution [8]

Method of control of air pollution, electrostatic precipitation wet & dries scrubber, filters, gravity and cyclonic separation, Adsorption, absorption and condensation of gaseous effluent

#### B] Method of control of water pollution [7]

Water and waste water treatment, aerobic and anaerobic, aeration of water, principle of coagulation, flocculation, softening, disinfection, demineralization and fluoridation.

### UNIT-III [15]

Sampling & analysis of air and water pollutants.

a) Methods of sampling gaseous, liquid and solid pollutants, analysis of CO, CO<sub>2</sub>, NO<sub>2</sub>,

SO<sub>2</sub>, H<sub>2</sub>S, CO<sub>2</sub>, analysis of toxic heavy metals, Cd, Cr, As, Pb, Cu, Separation of Co, Cu, Mg, Mn, Fe, analysis of

SO<sub>4</sub>

-2 P<sub>4</sub>

3-, NO<sub>3</sub>

-, NO<sub>2</sub>

-, analysis of total cationic and anionic burdens of water.

b) Pesticide, residue analysis soil pollution, Sources of pesticides residue in the Environment, pesticides degradation by natural forces, effect of pesticide residue on life, Analytical techniques for pesticides residue analysis.

UNIT-IV [15]

A] Radiation pollution-classification & effects of radiation, effects of ionizing radiation on man, Effects of non ionizing radiation on life, radioactivity and Nuclear fall out, protection and control from radiation.

B] Environmental toxicology

Chemical solutions to environmental problems biodegradability, principles of decomposition better industrial processes, Bhopal gas tragedy, Chernobyl, three mile island, sewozo and minamata disasters.

Reference Books:

1. Environmental Pollution, A.K. De
2. Air Pollution, Wark & Werner
3. Environmental Pollution Control in Process Industries, S.P. Mahajan
4. Environmental Pollution, B.K. Sharma & H.Kaur
5. Introduction to Air Pollution, P.K. Trivedi
6. Environmental Pollution Analysis, S.M. Khopkar
7. A Text Book of Environmental Pollution: D.D. Tyagi, M. Mehre
8. Environmental Pollution Engineering and Control, C.S. Rao
9. Chemical in the Environment, Satake & M. Midu
10. Environmental Sciences, E.G. Engel
11. Environmental Chemistry, B.K. Sharma & H.Kaur

## Paper No ICH 304B Bioinorganic Chemistry

### UNIT-I

#### Metals in Life Processes [15]

Na-K-charge carriers & osmotic pressure, relation to sensitivity of nerves and control on muscles, Mg-Ca complexes with nucleic acid, nerve impulse transmission, trigger reaction, Mn, Fe, Co, Cu, Mo, ferridoxins, Zn-super acid catalysis.

### UNIT-II

#### A] Oxygen Carrier Systems [8]

Structure and mechanism of hemoglobin, vitamin B12, B12 co-enzyme myoglobin, synthesis of oxygen carriers.

#### B] Photosynthesis [7]

Complexes of porphyrins porphyrins ring complexes, redox mechanism.

### UNIT-III

#### A] Nitrogen Fixation [8]

Nitrogen in biosphere, nitrogen cycle, nitrification role of microorganisms, nitrogen fixation in soils

#### B] Metal poisoning and drug action of Inorganic complexes compounds [7]

Metal poisoning, treatment by using chelating agent, mercury, lead & cadmium poisoning

& treatment. Platinum complexes in treatment of cancer, metal deficiency and use of metal chelates.

### UNIT-IV

#### A] Trace Metals in Plant Life [8]

Micronutrients in soil, role of micronutrients in plant life

#### B] Biogeochemistry [7]

Biodegradation of minerals bacteria leaching and its applications.

#### Recommended Books:

1. Eichhorn: Inorganic Biochemistry : Vol I , 2 Elsevier
2. Ochiai: Bioinorganic Chemistry: Allyn & Bacon Burton
3. Williams: an Introduction to Bioinorganic Chemistry, C.C. Thomos Spring III
4. Wallace: Decade on synthetic chelating agent in Inorganic plant nutrition, Wallace
5. Williams: Metals in Life
6. Zagic: Microbial Biogeochemistry, Academic press



7. Ahuja: Chemical Analysis of the Environment, Plenum press  
Paper No ICH304C Selected topics in Inorganic Chemistry

#### UNIT:I

##### 1. Catalysis [15]

a) Basic principles, thermodynamics and kinetic aspects, industrial requirements, classification, theories of catalysis, homogeneous & heterogeneous catalysis, reaction catalyzed by transition metal complexes and Organometallic compounds, Mechanism of reaction viz. Hydrolysis, polymerization, esterification, hydrogenation, ammonia synthesis, sulphur dioxide Oxidation.

b) Zeolites, synthesis of different zeolites, characterization, determination of surface acidity, shape, selectivity and application.

#### UNIT-II [15]

##### Inorganic Polymers

Classification, types of Inorganic polymers, Chemistry of following polymers a)

Silicones b) phosphonitric halides c) condensed phosphates d) coordinated polymers

e)silicates f) Isopoly & heteropoly acids

#### UNIT-III

##### Non conventional sources of energy [15]

##### a) Alternate source of energy

Solar sources: Photochemical methods, thermodynamic efficiency of energy conversion,

energy from solar radiations, transition metal complexes for energy production, solar hydrogen system, photochemical processes at semiconductors electrodes, photo galvanic

& Photovoltaic cells based on Inorganic photochemical systems.

b) Geothermal energy

c) Energy from biogas sources

d) Tidal wind sources

e) Energy from fission and fusion reaction.

#### UNIT-IV

##### Fertilizers [15]

Classification of fertilizers, nitrogen fertilizers, phosphate fertilizers, NPK fertilizers, H<sub>3</sub>PO<sub>3</sub> production without using H<sub>2</sub>SO<sub>4</sub>, position of fertilizer Industries in India.

Recommended Books:

1. Heterogeneous catalysis 2<sup>nd</sup> edn., Bond C. Chapman all (1987)
  2. The application & Chemistry of catalysis by suitable transition metal complexes Parashall. W. Weily N. 1980.
  3. Homogeneous transition metal catalysis, A general art, Masters C. Chapmann and Hall, London 1981.
  4. Introduction to the principles of heterogeneous catalysis, Thomas J.M., Thomas W.J. Academic press N.Y. 1967
  5. Inorganic polymers: Mark J.F., Allock H.R. West, Prentice hall
  6. Inorganic polymers: Ring N.H., Academic Press N.Y. 1978
  7. The Inorganic heterocyclic chemistry of sulphur, nitrogen, phosphorous, Heal A.G. Aca, Press N.Y. 1980.
  8. Solar energy Principles of thermal collections and storage, Sukhatme S.P., Tata Macgrow Hill New Delhi 1984.
  9. Fuel Cells, Bockeris JOM, Srinivasan S. and Mac grow Hills 1969
  10. Solar Energy Rai C.D.
  11. Energy Resources, Simon A.L. 1975
  12. Direct Energy Conversion, Addison Wesley, 1970, All M and Kottani S.
  13. Outlines in Chemical Technology Vol I, S.D. Sukla & Pandey G.N.
- M.Sc. II Practical Courses SEM - III, Inorganic Chemistry Course ICH - 311 & ICH 312
1. Ore Analysis - 3
  2. Alloy Analysis - 3
  3. Preparation of coordination complexes
  4. Ion exchange study of separation of mixtures & estimations
  5. Spectrophotometry
  6. Separation & estimation of ions using ion exchange chromatography
  7. Nephelometry
  8. Potentiometry
  9. Conductometry
  10. Thermal analysis
  11. Magnetic properties of transition metal complexes

12. Spectro Fluorimetry
13. Solvent extraction
14. Nuclear chemistry
15. Soil analysis
16. Data analysis

## SEMESTER-- IV

Paper No. ICH - 401, Instrumental Techniques

### UNIT-I [15]

X-ray & neutron diffraction

a) Fundamentals of x-ray diffraction

Theory of x-ray diffraction, diffraction of x-rays by crystals, determination of crystal structure (powder as well as single crystals), Instrumentation, determination of lattice parameters, x-ray intensity calculations and application of x-rays

b) Introduction to neutron diffraction, theory, Instrumentation and application.

### UNIT-II

Thermal method of analysis [15]

Thermogravimetry [TG], differential thermal analysis [DTA], differential Scanning calorimetry [DSC], Thermo mechanical analysis [TMA] Instrumentation and application, thermometric titrations.

### UNIT-III [15]

Mossbauer Spectroscopy

Introduction to Mossbauer effect, recoilless emission & absorption of x-rays, Instrumentation, isomer shift, Quadrupole splitting and hyperfine interactions, application

of Mossbauer effect to the investigations of compounds of iron and tin .

### UNIT-IV [15]

A) Electron spin Resonance [ESR] [8]

Principles of ESR, hyperfine splitting in simple systems, Instrumentation, factors affecting G values, applications to inorganic complexes.

B) Nuclear Quadrupole Resonance Spectroscopy [NQR] [7]

Introduction, effects of magnetic field on the spectra, relation between electric field gradient and structure, application of NQR.

Recommended Books:

1. Elements of x-ray diffraction, B.D.Cullity, Addison Wisley, 1967.
  2. Diffraction Method, Wormald, Oxford University, Press, 1973
  3. Standard Method of Chemical Analysis IIIA6th end.
  4. Neutron Scattering in Chemistry, Baun, G.E. Butleworth, London, 1971.
  5. Mossbauer Spectroscopy, Greenwood N.N., Gibbs T.C., Chapman Hall, 1971.
  6. Chemical Application of Mossbauer Spectroscopy, Goldanski V.I & Harber R.H., Academic Press 1968.
  7. Spectroscopy in Inorganic Compounds CNR Rao & Ferraro G.R., Academic Press, 1970.
  8. Basic Principles of Spectroscopy Cheney R. Mac Grows Hill, 1971.
  9. Thermal Method, Wendlandt, W.W. John, Wiley, 1986.
  10. Principles of Instrumental analysis, Skoog, III rd edn., Sounders, 1985/
- Paper No. ICH-402 CO-ORDINATION CHEMISTRY-II

#### UNIT-I [15]

A] Classification of Inorganic reactions, reaction intermediates, order of a reaction and reaction mechanism techniques to follow rate of reactions, liability of complexes and crystal field interpretation.

B] Substitution reaction, reactions of transition metal complexes, kinetics and mechanism

of substitution reactions of octahedral complexes, acid hydrolysis, base hydrolysis, kinetics and mechanism of substitution reaction.

#### UNIT-II [15]

A] Stereo chemical aspects of substitution reaction of Octahedral Complexes, Stereochemical changes in dissociation ( $SN_2$ ) and displacement ( $SN_2$ ) mechanism through various geometries of coordination compounds. Isomerization and r-acemization

reactions in octahedral complexes.

B] Substitution reaction of labile transition metal complexes

General discussion of some of the metal complexes, the effect of other

bonded liquids on rate, reaction in nonaqueous solvents.

C] Mechanism of atom and electron transfer reactions

Key ideas concerning electron transfer, outer sphere electron transfer and inner sphere electron transfer two electron transfer,  $[\text{Co}(\text{CN})_5]_3$  A redox & catalytic reagent.

### UNIT-III [15]

Photochemistry

Photochemistry of Coordination compounds, electronically excited states of metal complexes, types of photochemical reactions, substitution reactions, rearrangement reactions, redox reaction, and photochemistry of metallocene.

### UNIT-IV [15]

Optical rotation and circular dichroism (CD) curves, their use in Coordination Chemistry, principles, optically active molecules, optically rotatory dispersion, circular dichroism, fundamentals, relationship between optically rotatory dispersion (ORD) and circular dichroism (CD) curves.

Recommended Books:

1. F. Basolo & R. Pearson: Mechanism of Inorganic Reactions: A Study of Metal Complexes in Solution.
2. Obe, M.L. Inorganic reaction mechanism, Nelson, London, 1972.
3. Taube, electron transfer reactions of metal complex ions in solution. Academic Press, 1970.
4. E.S. Tould, Inorganic Chemistry
5. K.F. Purcell & J.C. Kotz, An Introduction to Inorganic Chemistry, Holt Rinehart, Japan.
6. V. Balzani & V. Cavassiti, Photochemistry of Coordination compounds, AP, London, 1970.
7. K. Burger, Coordination Chemistry Experimental Methods, Butterworth's
8. K.K. Rastogi & Mukharjee, Fundamentals of photochemistry, Wiley eastern
9. J.G. Calverts & J.N. Pitts, Photochemicals of Photochemistry, John Wiley
10. Wells, Introduction to Photochemistry.

Paper No ICH: 403 Chemistry of Inorganic Materials

UNIT-I [15]

#### A] Lattice Defects [8]

Introduction to types of Solids, Perfect & imperfect crystals, point defects, Line defect and plane defect defect (definition & explanation of meaning) order & disorder phenomena, thermodynamics of Schottky & Frenkel defect formation, Determination of defect, Nonstoichiometric defect (structural and thermodynamic aspects) incorporation of stoichiometric excess of defects, thermodynamics of Nonstoichiometric phases.

#### B] Synthesis of Inorganic materials [7]

Synthesis of solid state materials using different techniques ceramic techniques, co precipitation techniques, sol gel techniques, precursor techniques, high temperature & high pressure synthesis.

#### UNIT-II [15]

##### A] Ionic Conductors

Types of ionic conductors, mechanism of ionic conduction, interstitial jumps, vacancy mechanism, diffusion, super ionic conductors, phase transition & mechanism of conduction in super ionic conductors, examples and applications of ionic conductors.

##### B] Electronic properties of materials

a) Organic semiconductors, examples, properties and application

b) Superconductivity, superconductivity in metals, alloys and ceramics materials (mixed oxides) BCS theory, Meissner effect, type I & II superconductors, application Fullerenes as superconductors.

c) Dielectric polarization: piezoelectricity and Ferro electricity.

d) Lasers and Masers actions, laser production and application.

#### UNIT-III [15]

##### A] Magnetic properties of Materials

Introduction, Magnetization, Electron spin and magnetic moment, Theory of diamagnetism, Langevin's theory & paramagnetic susceptibility of solids, ferromagnetism,

Domain theory. Hysteresis in magnetism, ferrimagnetisms (ferries) Applications of magnetic materials.

##### B] Magnetic Materials

I] Structure and Properties of i) Metal and Alloys ii) Transition metal Oxides iii) Spinels iv) Ilmenites v) Perovskite and vi) Magneto-plumbites. II] Hard and Soft magnetic

materials , hysteresis loop and their application in transformer cores, magnetic bubble memory devices for information storage and permanent magnets III] Spin glasses:

Formation and characteristics.

UNIT-IV [15]

A] Advanced Inorganic Materials [8]

Nanotechnology and its business applications, Introduction to nanoscale, Potential applications of nanomaterials, Challenges and opportunities scope of nanotechnology, Commercialization scope Nanotechnology research in 21<sup>st</sup> century, Basic nanotechnology

science and chemistry concepts, basic nanostructures , nanocomposites, Thin films, nanofoam, nanoclusters, smart nanostructures, manufacturing techniques of nanomaterials.

B] Glass, ceramics, Refractory materials [7]

Glassy states, Glass formers and glass modifiers, applications, ceramic structures, mechanical properties, clay products, refractory characterization, properties.

Recommended Books

1. Solid State Chemistry: A.H. Hanny
2. C.N.R. Rao, Solid State Chemistry : Dekker
3. Wilcox : Preparation and Properties of Solid State Materials: Vol I & II, Dekker
4. Hagenmuller, Preparative Methods in Solis State Chemistry
5. Lohn Wulff, The Structure and Properties of Materials Vol. IV, Electronic Properties (Wily Eastern)
6. N.N. Greenwood: Ionic Crystals, Lattice Defects and Nonstiochiometry (Butterworth's)
7. L.V. Azorooof and J.J. Brophy: Electronic Processes in Materials, MacGraw Hills.
8. T.J. Rey et al : The Defect Solid State ( Interscience)
9. E.A. Kroger, Chemistry of Imprefect Crystals (Holland)
10. A.R. West, Solid State Chemistry
11. H.V.K Keer, Principles of the Solid State Chemistry, Wiley Eastern.
12. S.O. Pillai Academic press: Solid state physics

Paper No. ICH 404 A Separation Science

## UNIT-I [15]

### Solvent Extraction Separation

Principles of solvent extraction, formation of metal complexes, distribution of extractable species, quantitative treatment of extractable equilibria, Methods of extraction, techniques in extraction, application of diketone, hydroxyquinoline, oximes, dithiocarbamates, xanthates, thiols, macrocyclic polyethenes and organo phosphorous compounds in solvent extraction. Separation of nonmetals and metals.

## UNIT-II [15]

### Chromatographic separation techniques

Extraction chromatography, theoretical aspects of extraction chromatography, correlation

between solvent extraction and extraction chromatography, techniques in extraction chromatography, chromatographic inert support, stationary phases, use of extraction chromatography for separation of fission products.

## UNIT-III [15]

### 1. Ion exchange separation

Fundamental properties of ion exchangers, theories of ion exchange, exchange capacity,

screening effect, penetration of electrolytes into the ion exchange resins, sorption of complex ions, ion exchange equilibrium, column operation, theory of break through curves, elution steps, use of non aqueous solvents in ion exchange separation, application

of ion exchange separation in determination of total salt concentration, removal of interfering ions, separation of anions and metals.

## UNIT-IV [15]

### A] Separation by electrolysis [8]

Basic principles, over potentials, electrogravimetry, constant current electrolysis, separation with controlled electrode potentials, constant voltage electrolysis, potential buffers, and physical characteristics of metal deposits, internal electrolysis, electrography, electrophoresis, and electro chromatography.

### B] Gas Chromatography [7]

Principles of gas chromatography, plate theory of gas chromatography, Instrumentation



for gas chromatography, working gas chromatography, application of gas chromatography, programmed temperature chromatography, flow programming chromatography, gas-solid chromatography, and hyphenated techniques in chromatography Problems.

Recommended Books:

1. Solvent extraction in analytical A chemistry by G.H. Morrison, F. Frieiser, John Wiley & Sons, NY.
2. Ion exchange and solvent extraction of metal compounds by Y. Macros, A.S.Kertes, Wiley, Interscience.
3. Solvent extraction Chemistry, Selkine and alegagawa.
4. O.Samuelson, Ion exchange separation in Analytical Chemistry, J.Wiley & Sons.
5. A.I.Vogel, A Text Book of quantitative Inorganic Analysis, Longmann Green.
6. D.A. Skoog & D.M. West, Fundamentals of Analytical Chemistry - Holy Rinchart.
7. G.W. Ewing, Instrumentation Methods of Chemical Analysis, McGraw Hills.
8. S.M. Khopkar, Basic Concepts of Analytical Chemistry.
9. D. Ambrose and B.A. Amborse, As chromatography.

Paper No. CHI 404B, Radiation Chemistry

UNIT-I [15]

A] Isotopes

Isotope separation, thermodynamic and kinetic isotope effects, isotope exchange reaction

kinetics, determination of exchange rate constant, production of radio isotopes.

B] Biological effects of Radiation.

Introduction, genetic and somatic effect on human being, effect of radiation on plants and

aquatic Environment

UNIT-II [15]

Radiochemical Separation

The need of radiochemical separation techniques, carrier techniques, isotope and nonisotopic carriers, co precipitation and adsorption, ion exchange, solvent extract, electrolytes behavior of carrier free tracer radionuclide.

UNIT-III [15]

Principle of tracer chemistry

Application of tracers in physiochemical studies, diffusion studies, isotopic and exchange

reactions, tracer in the study of the mechanism of the inorganic chemical reaction, atom transfer & electron transfer mechanisms. Heterogeneous catalysis and surface area measurements, radio carbon dating, tracer studies with tritium, application in metallurgy and preservation of food, geochemical application and hot atom chemistry.

UNIT-IV

Radiation detection and measurements. [15]

Ionization current measurements, multiplicative ion collector, methods not based on ion collection, auxiliary instrumentation and health physical instruments and counting statistics.

Recommended Books.

1. Friendlander, Kennedy & Miller, Nuclear and radio Chemistry, ohm Wiley.
2. B.G. Harvey, Nuclear Chemistry.
3. Haissinsky, Translated by D.G. Tuck, Nuclear physics and Chemistry.
4. Mark lefort, Nuclear Chemistry, D.V. Nostrand.
5. An N.Nesmeyanov, Radiochemistry, Mir.
6. Jacobs, et al, Basic Principles of nuclear science and reactors, V.Nost, EWAP.
7. N.Jay, Nuclear power, today tomorrow, ELBS.
8. Kenneth, Nuclear power, today and tomorrow, ELBS.
9. Essentials of Nuclear Chemistry, J.Arnika, John Wiley.
10. D.C. Dayal, nuclear physics.

Paper No. C 404C Organometallic Chemistry.

UNIT-I [15]

A] Methyl derivatives of metals [8]

Structures, bonding, classification of methyl derivatives of metals, cleavage of metal carbon bonds, thermochemical consideration.

B] Catalytic processes [7]

Carbonylation, hydrogenation, isomerisation of olefins, olefin oxidation, oligomerization,

polymerization.

#### UNIT-II [15]

##### Organometallic synthesis

Radicals + metals, carbonyls, olefins complexes, addition of metal hydrides to unsaturated carbons,, addition of metal alkyls to unsaturated hydrocarbons, substitution reactions, Hydrocarbons + metal Organometallic + metal, metallation, metal halogen exchange reactions, Mercuration & related covalent metallation reactions of Organometallic compounds with metal salts, reactions of bimetallic compounds and halides, ligand exchange reactions of diazoalkanes with metal hydrides and halides, addition of M-OR to C=c, electrolyte reduction using metal cathode, decarboxylation.

#### UNIT-III [15]

##### A] Properties of reactions of Organometallic compounds [8]

Complex formation, reactions with active oxygen compounds, reactions with halogen, reactions with alkyl halides, acid halides, reactions with oxygen, carbonyls and others.

##### B] Metal carbonyls, isocyanides and acetyl ides. [7]

Preparation, structure, reactions of metal carbonyls with alkyl halides, reactions of metal carbonyls with metal alkyls, cyanides and isocyanides complexes, acetalynide complex adduct formation. Complexes: 2,3,4,5,6 and 7 electron donor carbametallic compounds, aromaticity of cyclopentadienyls.

#### UNIT-IV

##### .Techniques of Organometallic Chemistry [15]

Methods of synthetic chemistry, vacuum techniques, inert atmosphere, nonaqueous media, handling and hazards of organ metallic.

Recommended books.

1. Paulson, Organometallic Chemistry -Arnold.
2. Rochow, Organometallic Chemistry - Reinhold.
3. Zeiss, Organometallic Chemistry - Reinhold.
4. Advances in Organometallic Chemistry A.P.

Practical Course Sem -IV

PR (I) 411 & PR (I) 412A)

1. Ore analysis (Three)
2. preparation of coordination compounds(Three) and preparations of mixed metal oxides (two)
3. Ion exchange chromatography; separation of multicomponent mixtures

4. Solvent extraction
5. Spectrophotometry
6. Ph Metry
7. Conductometry
8. Polarography
9. Electrogravimetry
10. Nuclear and radiochemistry

B) Interpretation exercises

1. X-ray powder diffraction analysis of cubic compound
  - a. Determination of lattice constants and geometry
  - b. Partical Size
  - c. Density
2. Interpretation of Mossbaur spectrum with reference to determination of a) isomer shift b) quadruple splitting c) Internal magnetic field d) general comment
3. Interpretation of IR spectrum with reference to stretching vibration 0-2 C=N, C=O, N-, M-O
4. Interpretation of NMR spectrum with reference to calculation of chemical shifts and general comments.
5. Interpretation of absorption spectra for
  - a. Verification of position of ligands in spectrochemical series.
  - b. Determination of gemetry (Octahedral, square planer, tetrahedral) of a given compound.
  - c. Calculation of spectral splitting parameters.
6. Interpretation of polar gram for determination of half wave potentials and unknown concentration.
7. Calculation of band gap of semiconductors with the help of plots of log  $\epsilon$  vs.  $10^{3/4}$ .

In all 20 experiments with at least five expts in each course should be completed.

Addition of new expts in place of existing one may be allowed. A variety of small projects designed by by teacher based on the interest of ttu stule and capabilities should

be worked out. Project work and the review report will be examined by internal and external examiners.

M.Sc- II

Paper No. OCH-301.

Organic reaction mechanism

UNIT-I. Methods of determining reaction mechanism: [15]

Kinetic & non-kinetic methods of determining reaction mechanism. Hammett equation & Taft equations.

UNIT-II. Reactive Intermediates: [15]

Carbenes, nitrenes, arynes reactions, Phosphorous, nitrogen and sulphur yields, methods of generation and reactivity and applications. Non-classical carbocations.

UNIT-III

Study of following reaction: [ 15 ]

Mechanism, Stereochemistry, migratory aptitude, (application using complicated example): Favorskii, Baeyer-Villiger, Chichibabin, Dienone –Phenol , Pinacol- Pinacolone, Suzuki Coupling, Wolff, Smile's & Michael reactions

UNIT-IV Photochemistry: [15]

Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions, photodissociation gas phase photolysis, photochemistry of alkynes, intramolecular reactions of the olefinic bonds, geometrical isomerism, cyclisation reactions, rearrangements of 1,4 and 1,5 dienes, photochemistry of carbonyl compounds, intramolecular reactions of carbonyl compounds saturated cyclic and acyclic  $\alpha,\beta$  unsaturated compounds, cyclohexadiones, intermolecular cycloaddition reactions, dimerisation and oxirane formation, photochemistry of aromatic compounds, miscellaneous photochemical reactions, photo fries reactions of anilides, photo fries rearrangements. Singlet molecular oxygen reactions, photochemistry of vision.

Books suggested:

1. A guide book to mechanism in organic chemistry

(orient- Longmans)- Peter Sykes

2. Organic Reaction Mechanism (Benjamin)- R. Breslow

3. mechanism and structure in Organic Chemistry

(Holt Reinhartwinston)- B. S. Gould

4.Organic chemistry (McGraaw Hill)- Hendrikson, cram and Hammond

5.Basic principles of organic chemistry (Benjamin)

J. D. Roberts and M. C. Caeserio.

6.Reactive intermediates in organic chemistry, (J. Wiley ) N. S. Issacs.

7.Organic reaction mechanism (Mc Graw Hill ) R. K. Bansal

8.Fundamentals of photochemistry K. K. Rohtagi- Mukherji Wiley- Eastern

9.Essentials of molecular photochemistry, A. Gilbert and J. Baggott. Blackwell Scientific Publication.

10.Molecular photochemistry, N.J. Urro, W. A. Benjamin

11.Introductory photochemistry. Cox and T. Camp Mc Graw –Hill

12.Photochemistry R.P. Kundall and A. Gilbert. Thomson Nelson.

13.Organic photochemistry J. Coxon and B. Hallon Cambridge University press.

Paper No. –302

Advanced Spectroscopic methods

UNIT-I

a) Ultraviolet Spectroscopy 6

Woodward- Fisher rules for conjugated dienes and carbonyl compounds; Calculation of  $\lambda_{max}$ . Ultraviolet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls.

b) IR Spectroscopy 9

Characteristic vibrational frequencies of alkanes; alkenes; alkynes; aromatic compounds; alcohols; ethers; phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds [ketones; aldehydes; esters; amides; acids; anhydrides; lactones; lactams and conjugated carbonyl compounds] Effect of hydrogen bonding and solvent effect on vibrational frequencies; overtones; combination bands and

Fermi resonance. FT-IR of gaseous; solids and polymeric materials

UNIT-II NMR Spectroscopy 15

General introduction and definition; chemical shift; spin –spin interaction; shielding mechanism of measurement; chemical shift values and correlation for protons bonded to

carbons [aliphatic; olefinic; aldehydic and aromatic] and other nuclei [alcohols; phenols;

enols; acids; amines; amides and mercapto]; chemical exchange; effect of deuteration;

complex spin-spin interaction between two; three; four; and five nuclei [first order spectra]; virtual coupling. Stereochemistry; hindered rotation; Karplus curve variation of coupling constant with dihedral angle. Simplification

Simplification of complex spectra; nuclear magnetic double resonance; shift reagent; solvent effect. Fourier transform technique; nuclear overhauser effect [NOE] Resonance of other nuclei – F; P.

#### UNIT-III Mass Spectrometry 15

Introduction, ion production- EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement, nitrogen rule. High-resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

#### UNIT –IV [15]

##### a) Carbon-13 NMR Spectroscopy 6

General considerations; chemical shift [aliphatic; olefinic; alkyne; aromatic; heteroaromatic and carbonyl compounds]; problems associated with  $^{13}\text{C}$ , FT-NMR, proton decoupled off resonance.

b) Structural problems based on combined spectroscopic techniques. 9 Books suggested.

1. V.M. Parikh, Application spectroscopy of organic molecules. (Mehata)
2. D.W. Williams and Fleming, Spectroscopic methods of organic compound.
3. Silverstein and Basallar, Spectroscopic identification of organic compounds V.M. Parikh ORPTION SPECTROSCIPY OF ORGANIC MOLECULES ( J. Wiley )
4. P.S. Kalsi Spectroscope of organic compounds ( New age publisher )
5. J.R. Dyer. Application of absorption spectroscopy of organic compounds.
6. Jackman and Sterneil , Application of NMR spectroscopy
7. J.D. Roberts, Nuclear magnetic resonance (J. Wiley)
8. Jafee and Orchin, Theory and application of U.V,
9. K. Benjamin. Mass spectroscopy
10. Beynon J H et.al , The mass spectra of organic molecules.

11. Wehli F.W, Marchand A. P. Interpretation of carbon 13 NMR ( J. Wiley )

12. W. Kemp, Organic spectroscopy ELBS

13. Willard Merritt and Dean. Instrumental methods of analysis CBS

14. Das and Jame , Mass Spectroscopy.

Paper No. OCH-303

Advanced Synthetic methods

UNIT-I Disconnection approach : [15]

An introduction to Synthons and synthetic equivalents, disconnection approach, functional group interconversions. One group C-X and two group disconnections in 1,2,1,3 -,1,4-& 1,5- difunctional compounds , Retro- synthesis of Alkene ,acetylenes and aliphatic nitro Alcohols and carbonyl compounds, amines , the importance of the order of

events in organic synthesis, chemoselectivity, regioselectivity. Diels Alder reaction, Michael addition and Robinson annulation. Retro- synthesis of aromatic Heterocycles and 3, 4, 5 and 6 membered carbocyclic and heterocyclic rings.

Reversal of polarity (Umpolung).

UNIT-II [15]

a) Protecting Groups: Principle of protection of alcohol, amine, carbonyl and carboxyl groups [7]

b) Application of the following in synthesis [ 8 ]

c) Merrifield resin, polymeric reagents. Solid phase synthesis of polypeptide &

d) oligonucleotides, electro organic synthesis, enzyme catalyzed reaction in synthesis &

e) resolution of racemic mixtures.

f) UNIT-III

g) Application of following reagents & reaction in synthesis. [15]

h) Complex metal hydrides, lithium dialkyl cuprate, lithium diisopropylamide

i) (LDA) Dicyclohexylcarbodiimide(DCC), Trimethyl silyl iodide, tributyltin hydride,

j) peracids, lead tetra acetate, PPA, Diazomethane , ozone phase transfer catalyst,

k) woodward-prevost hydroxylation, Barton and Shapiro reaction Hoffmann – Loffler-

l) Fretag, Miyamura, Stille, Negishi, Kamada Peterson synthesis

m) UNIT-IV [15]



- n) a) Selenium dioxide, crown ethers, DDQ, Dess-Martin periodinane, periodic acid &
- o) Iodoisobenzyl diacetate. [7]
- p) b) Application of following metal in organic synthesis [8]
- q) Pd, Hg, and Rh, Tl and Si
- r) RECOMMENDED BOOKS
- s) 1.S.Warren: Designing of organic synthesis
- t) 2.J. Fuhrhop & G. Penzlin. : Organic synthesis (2<sup>nd</sup> ed.)
- u) 3.Carruthres: some modern methods of organic synthesis.
- v) 4.H.O.House: modern synthetic reaction.
- w) 5.Fieser & Fieser : Reagent in organic synthesis
- x) 6.R.O.C.Norman: principle of organic synthesis
- y) 7.CAREY & Sundharg: Advanced organic Chemistry
- z) 8.P.E.REALAND: Organic synthesis
- aa)9.Bartan and Ollis : comprehensive organic Chemistry
- bb)10.R.Admas: - organic reactions
- cc) 11.Stone & west: Advances in organometallic Chemistry
- dd)12.C.W.Bird: Transition metal intermediate in organic synthesis
- ee)13.Swan & black :organometallic in organic synthesis.
- ff) 14.A. Mitra : synthesis of prostaglandins
- gg)15.John Apsimon: Total synthesis of natural products
- hh)16. M. K. Mathur, C. K. Narang & R.E.Williams: polymers as aid in organic
- ii) synthesis
- jj) 17.P. HODGE & D.C.SHERRINGTON: Polymer supported reaction in organic
- kk) synthesis.
- ll) 18.C.J.Gray: Enzyme catalysed reaction s
- mm) 19.T.W. Green & P.G.M.Wats : Protecting groups in organic Chemistry
- nn)20.T.Shona: Electroorganic Chemistry
- oo)21.Weber & Gokel : phase transfer catalyst in organic synthesis.
- pp) 22. Protecting group chemistry J. Robertson (OX)  
 Paper No. OCH. 304  
 (DRUG & HETEROCYCLIC)

#### UNIT-I [15]

##### a) Drug design [7]

Development of new drugs, procedures followed in drug design, concepts of prodrugs and soft drugs. Theories of drug activity, Quantitative structure activity relationship. Theories of drug activity, Quantitative structure activity relationship. History and development of QSAR. Concepts of drug receptors

##### b) Study of the Following types of drugs: [8]

a) Antibiotics: Preparation of semi synthetic penicillin, conversion of penicillin into cephalosporin, general account of tetracycline & macrocyclic antibiotics(no synthesis)

b) Antimalerials: Trimethoprim

c) Analgesic & Antipyretics: Paracetamol, Meperidine, methadone, Aminopyrine.

#### UNIT-II [15]

##### a)

i) Anti- inflammatory: Ibuprofen, Oxyphenylbutazone, Diclophenac, Indomethacin.

ii) Antitubercular & antileprotic : Ethambutol, Isoniazide & Dapsone

iii) Anaesthetics : Lidocaine, Thiopental.

iv) Antihistamines: Phenobarbital, Diphenylhydramine.

v) Tranquilizers: Diazepam, Trimeprazine.

vi) Anti AIDS: General study

vii) Cardiovascular: Synthesis of diltiazem, quinidine, methyldopa, atenolol, oxyprenol

viii) Anti-neoplastic drugs: Cancer chemotherapy, Synthesis of mechloreaethamine, cyclophosphamide, Mephalan, uracils, mustards. Recent development in cancer chemotherapy. Hormones and natural products.

#### UNIT-III [15]

##### a) Small ring Heterocycles [8]

Three membered and four membered Heterocycles- synthesis and reactions of aziridines,

oxiranes, thiranes, azetidines, oxitanes and thietanes.

##### b) Benzo fused five membered Heterocycles [7]

Synthesis and reactions of benzopyrroles, benzofurans and benzothiophenes.

#### UNIT-IV [15]

a) Six membered Heterocycles with one heteroatom [5]

Synthesis and reactions of pyrilium salts and pyrones and their comparison pyridinium and thiopyrylium salts and pyridones. Synthesis and reactions of coumarins, chromones.

b) Six membered Heterocycles with two and more Heterocycles [5]

Synthesis and reactions of diazines & triazines.

c) Seven membered Heterocycles [5]

Synthesis and reactions of azepines, oxepines & thiepinines.

#### RECOMMENDED BOOKS

1. Burger : Medicinal Chemistry.

2.A. Kar : Medicinal Chemistry (Wiley East)

3. W. O. Foye : Principals of medicinal chemistry.

4. Wilson, Gisvold & Dorque: Text book of organic medical and pharmaceutical chemistry

5. Pharmaceutical manufacturing encyclopedia.

6. R. M. Acheson : An introduction to chemistry of heterocyclic compounds (Interscience).

7. Joule & Smith : Heterocyclic chemistry (Van Nostrand).

8. R. K. Bansal: Heterocyclic chemistry (Wiley E).

9. L. A. Paquette : Principals of modern heterocyclic chemistry.

10. M. H. Palmer : The structure and reactions of heterocyclic compounds.

11. A. R. Katritzky: Advances in Heterocyclic chemistry (A.P.).

12. Finar: Organic chemistry (Vol. 1& 2)

13. Cohn & Stumpt : Outline of Biochemistry.

14. Williams : Introduction to the chemistry of enzyme action.

15. The Organic Chemistry of Drug design and Drug action, R. B. Silverman Academic press.

16. Strategies for Organic Drug synthesis and Design, D. Lednicer, J. Willey.

17. Heterocyclic Chemistry, Vol-1-3, R. R. Gupta, M. Kumar and V. Gupta, Springer Veriag.

18. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme

19. Heterocyclic Chemistry, J. A. Joule, K. Mills and G. F. Smith, Chapman and Hall

20. Heterocyclic Chemistry, T. L. Gilchrist, Longman Scientific Technical

21. Contemporary Heterocyclic Chemistry, G. R. Nikome and W. W. Poudler, Willey.

22. An Introduction to Heterocyclic Compounds, R. M. Acheson, J. Willey

23. Comprehensive Heterocyclic Chemistry, A. R. Katrizky and C. W. Rees

Organic Chemistry Practicals

OCH-11: SEM-III

A. Qualitative Analysis

Separation, purification and identification of compounds of binary mixture ( one liquid and one solid) using the TLC and column chromatography, chemical tests. IR spectra to be used for functional group identification.

B. Quantitative analysis

1. Three step Preparations

2. Colorimetry and pH metry experiments.

3. Expt. on Hammett equation

Recommended Books :

1. Textbook of Practical Organic Chemistry – A. I. Vogel.

2. Practical Organic Chemistry – Mann & Saunders.

3. A Handbook of Quantitative & Qualitative Analysis- H. T. Clarke.

4. Organic Synthesis Collective Volumes by Blat.

Semester-IV (Organic Chemistry)

Paper No-OCH-401:

Theoretical Organic Chemistry

UNIT-I Molecular Orbital Theory: [15]

Aromaticity in benzenoids, alternant and non alternant hydrocarbon, Huckels rule, energy

level of pi molecular orbital and concept of aromaticity, calculation of energies of orbitals in cyclic and acyclic systems. Determination energies and stabilities of different systems calculation of charge densities PMO theory and reactivity index.

UNIT-II Non benzenoid aromatic Compounds: [15]

Aromaticity in Non- benzenoids compounds Annulenes and hetroannulenes, fullerence C<sub>60</sub> , Tropone, tropolone azulene, fulvene, tropylium salts, ferrocene, Three and five

membered systems. Crown ether complexes, cyclodextrins, cryptands, catenanes and rotaxanes, bonding in fullerenes.

#### UNIT-III [15]

##### a) Free radical reactions: [ 8 ]

Types of free radical reactions, detection by ESR, free radical substitution mechanism, mechanism at an aromatic substrate, neighboring group assistance.

Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in attacking radicals. The effect of solvent on reactivity. Allylic hydrogenation ( NBS ) , oxidation of aldehydes to carboxylic acids, auto oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salt, Sandmeyer's reaction. Free radical rearrangement, Hunsdiecker reaction.

##### b) Pericyclic Reactions: [7]

Molecular orbital symmetry, Frontier orbital of ethylene, 1,3 butadiene, 1,3,5 hexatriene and allyl system, classification of pericyclic reaction, Woodward-Hoffman correlation diagrams, FMO and PMO approach, electrocyclic reactions, conrotatory and disrotatory motions,  $4n$  ,  $4n+2$  and allyl systems, cycloaddition , and supra and antarafacial additions,  $4n$  and  $4n+2$  systems,  $2+2$  additions of ketenes, 1,3 dipolar cycloaddition and chelotropic reactions, sigmatropic rearrangement , supra and antarafacial shifts of H Sigmatropic shifts involving carbon moieties, 3,3 and 5,5

sigmatropic rearrangement and Claisen and Cope and Aza Cope rearrangement, Ene reaction.

#### UNIT-IV [15]

##### a) Kinetic and thermodynamic control of reactions:

Reactions of naphthalene, Wittig reaction, enolization, Friedel-Crafts reactions, Diels Alder. [8]

##### b) Reactions of carboxylic acids and esters [7]

Types of hydrolysis mechanisms catalyzed by acids and bases.

Recommended Books:

1. Lehar and Merchant: Orbital Symmetry.
2. R. B. Woodward and Hoffman: Conservation of orbital symmetry.
3. Kan: Organic Photochemistry
4. Cixon and Halton : Organic photochemistry

5. Arnold: Photochemistry
6. N. Turro : Modern molecular photochemistry
7. Rohatgi- Mukherji : Fundamentals of photochemistry.
8. Ginsburg: Nonbenzenoid aromatic compound
9. A. Streitwieser : Molecular orbital theory for organic chemistry.
10. E. Cler : The aromatic sextet.
11. Lloyd: Carbocyclic non- benzenoid aromatic compounds.
12. W. B. Smith; Molecular orbital methods in organic chemistry.
13. Grratt; Aromaticity.

Paper No. OCH- 402:

Stereochemistry

UNIT-I Newer methods of stereoselective synthesis: [15]

Introduction and stereoselective and stereospecific reactions. Enantioselective synthesis (chiral approach) reactions with hydride donors, hydroboration, catalytic hydrogenation via chiral hydrazones and oxazolines. Sharpless epoxidation. Diels Alder selective synthesis, use of calculations of optical purity and enantiomeric excess.

UNIT-II [15]

a) Conformation and reactivity in acyclic compounds and of cyclohexanes. [5]

Stability and reactivity of diastereoisomers. Curtin- Hammett principle,

b) Some aspects of the stereochemistry of ring systems: [5]

Stereoisomerism and determination of configuration Stability of rings and ease of rings formation)

c) The shapes of the rings other than six membered: [5]

Shapes of five, six, and seven membered rings. Conformational effects in medium sized rings, Concept of I strain.

UNIT-III [15]

a) Fused and bridged rings: Fused bicyclic ring systems : [8 ]

Cis and trans decalins and perhydrophenanthrene. Bridged rings, Nomenclature stereochemical restrictions, and The Bredt's rule, Reactivities.

b) O.R.D. and C.D. : Types of curves, the axial haloketone rule. [7]

The Octant rule. Determination of conformation and configuration.

UNIT-IV

a) Stereochemistry of Allenes, Spiranes and Biphenyls [8

### Assignment of configuration

b) Configuration of diastereomers based on physical and chemical methods. [7]  
Recommended Book

- 1.E.L. Eliel : Stereochemistry of carbon compounds
- 2.D. Nasipuri : Stereochemistry of organic compounds
- 3.P.S. Kalsi: Stereochemistry: conformation and Mechanism.
- 4.Eliel, Allinger, Angyal and Morrison : Conformational analysis
- 5.Hallas: Organic stereochemistry
- 6.Mislow and Benjamin: Introduction to stereochemistry.
- 7.H. Kagan : Organic stereochemistry.
8. Carl Djerassi ; Optical rotatory dispersion.
- 9.P. Crabbe : Optical rotatory dispersion and C.D.

Paper No. OCH-403

Chemistry of Natural Products

UNIT-I Terpenoids [15]

Structure and synthesis of abietic acid, zingiberene, santonin, cuparenone and caryophyllene.

UNIT-II Alkaloids [15]

Structure, stereochemistry, synthesis and biosynthesis of the following Structure of morphine, reserpine, ephedrine, (+) Conin.

UNIT-III [15]

a) Steroids [8]

Occurrence, nomenclature, basic skeleton, Diels hydrocarbon and study of the following hormones, Androsterone, Testosterone, Estrone, Progesterone, Aldosterone and cortisone.

Biosynthesis of steroids.

b) Prostaglandins [7]

Occurrence, nomenclature, classification, biogenesis and physiological effects,

Synthesis of PGE<sub>2</sub> and PGF<sub>2</sub>

UNIT-IV [15]

a) Biogenesis [8]

Alkaloids (pyridine, morphine and indole type) terpenoids of classes with examples, cholesterol, flavones, coumarins, carbohydrates and proteins.

b) Vitamins [7]

Synthesis and structure of biotin and vitamin B<sub>2</sub>, synthesis of vitamin B<sub>1</sub>, biological functions of B<sub>6</sub>, B<sub>12</sub>, folic acid and thiamin.

Books Suggested

1. Apsimon: The total synthesis of natural products.

2. Manskey and Holmes: Alkaloids

3. A.A. Newmen: Chemistry of Terpenes.

4. P. D B.Mayo: The chemistry of natural products.

5. Simonson: Terpenes.

6. T.W. Goddwin: Aspects of terpenoid chemistry and biochemistry

7. Woguer: Vitamins and Co enzymes.

8.P. W. Bently: Chemistry of Natural products,

9. Fieser and Fieser: Steroids

10. I. Finar: Organic chemistry Vol. II and I

11. J.B. Hendrickson, The molecules of nature.

12. Peter Bernfield, The biogenesis of natural products,

13. R.T. Slickenstaff A.C. Ghosh and G.C. Wole , Total synthesis of steroids.

14. The chemistry of natural products, vol. Nakanishi

Paper No. OCH- 404A:

Applied Organic Chemistry

UNIT-I Agrochemical: [15]

a. Carbamate pesticides: Introduction, carbaryl, Baygon, Aldicarb, Ziram, Zineb

b. Organophosphorus pesticides: Malathion, monocrotophos, dimethoate, phorate, mevinphos

c. Natural and synthetic pyrethroids : Isolation and structures of natural allethrin, fenvalerate, cypermethrin,

d. Plant growth regulators: General survey synthesis of simple compounds

e. Insect repellents: General survey and synthesis

f. Jovenile hormone: introduction structures JHA importance synthesis



g. Pheromones: introduction, examples, and importance in IPM synthesis of juvabione bombycol, grandisol, and disparure

UNIT-II Manufacture of following: [15]

2-Phenylethanol, detergents, vanillin and other food flavours, synthetic musk , Acetic acid and butanaldehyde from ethanol butyl acetate, furfural, from bagasse, citric acid from molasses, Application of oro and marker process. Nicotine from tobacco waste

and citral from lemon grass, synthetic detergents, glycerol.

UNIT-III Dyes and Intermediates: [15]

Synthesis of important dye intermediates. Commercial processes for Azo dyes, reactive dyes, optical brighteners, thermal sensitive dyes, dispenses dyes.

UNIT-IV Polymers: [15]

Mechanism of polymerization. Study of polyesters, polyamides, PVC, polystyrene, polyvinyl acetate and polyvinylalcohol, polyethenes, viscose rayon, synthesis of polyethylene, polypropylene. Synthetic rubbers: Styrene-butadiene, butyl polyisoprene, phenol formation formaldehyde resin. Plasticisers and anti oxidants for polymers, Natural polymers: Starch and cellulose.

Reference Books

1. Allan: Colour Chemistry
2. K. Venkataraman: Chemistry of Synthetic Dyes Vol- 1 to 7
3. Abrahart: Dyes & their intermediates
4. N. N. Melikov: The Chemistry of Pesticides and formulations
5. K. H. Buchel: Chemistry of Pesticides
6. R. Cleymlin: Pesticides
7. F. W. Billmeyer: Text book of Polymer Science
8. H. R. Alcock and F. W. Lambe: Contemporary Polymer Chemistry
9. J. M. G. Cowie, Blackie: Physics & Chemistry of Polymers
10. P. H. Groggins: Unit Processes in Organic Synthesis
11. B. Biollot & P. V. Wells: Perfumary Technology
12. M. Ash & I. Ash: A formulary of Cosmetic Preparations

Paper No. OCH-404-B

Bio organic chemistry (elective)

UNIT-I

a) Cell Structure and Functions [10]

Structure of prokaryotic and eukaryotic cells, Intracellular organelles and their functions, comparison of plant and animal cells. Overview of metabolic processes catabolism

and anabolism. ATP – the biological energy currency. Origin of life- unique properties of carbon, chemical evolution and rise of living system. Introduction to biomolecules, building blocks of bio- macromolecules.

b) Enzymes [5 ]

Structure activity and reactions, catalyzed determination of active site, inhibition mechanism chemical transformations using enzyme.

UNIT-II Carbohydrates [15]

Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars.

Naceylmuramic

acid, sialic acid disaccharides and polysaccharides. Structural

polysccharides- cellulose and chitin. Storage polysaccharides- starch and glycogen.

Structure and biological functions of glucosaminoglycans or mucopolysaccharides.

Carbohydrates of glycoprotines and glycolipides. Role of sugars in biological recognition. Blood group substances. Ascorbic acid.

Carbohydrate metabolism- Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, pentose phosphate pathway.

UNIT-III Lipids [15]

Fatty acids, essential fatty acids, structures and function of triglycerides, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins.

Lipoproteins composition

and function, role in arthrosclerosis.

Properties of lipid aggregates – micelles, bilayers, liposomes and their possible biological functions. Biological members . Fluid mosaic model of membrane structure.

Lipid metabolism -  $\beta$ -oxidation of fatty acids

UNIT-IV

a) Amino acids, Peptides and Proteins [10]

Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing.

Secondary structure of protein, forces responsible for holding of secondary structures.

α-

helix, β-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of protein- folding and domain structure. Quaternary structure.

Amino acid metabolism- degradation and biosynthesis of amino acids, sequence determination: chemical/ enzymatic/ mass spectral, racemization/ detection. Chemistry of

oxytocin and tryptophan releasing hormone (TRH).

b) Nucleic Acids [5]

Purine and pyrimidine of nucleic acids, base pairing via H – bonding. Structure of ribonucleic acids (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and poly nucleosides.

Books Suggested

- 1.Principles of Biochemistry, A. L. Lehinger, Worth Publications.
- 2.Biochemistry, L. Stryer, W. H. Freeman.
- 3.Biochemistry, J. David Rawn, Neil Patterson.
- 4.Biochemistry, Voet and Voet, John Wiley.
- 5.Outlines of Biochemistry, E. E. Conn and P. K. Stumpt, John Wiley.

ORGANIC CHEMISTRY (PRACTICALS)

OCH-411 & OCH-412

Three stage preparations starting with 5g or less & TLC.

1. Estimation of sulphur, nitrogen and functional groups, pharmaceutical analysis.
2. Polyfunctional analysis
3. Organic preparations
  1. Preparation of benzanilide by Beckmann rearrangement
  2. Preparation of anthranilic acid
  3. Preparation of phthalimide
  4. Preparation of N- bromosuccinamide
  5. Preparation of p- Amino benzoic acid
  6. Preparation of p- chloro nitrobenzene by Sandmeyer reaction

7. Preparation of p- Idonitrobenzene by Sandmeyer reaction
8. Pinacol- Pinacolone rearrangement
4. Project: Literature survey. Studies of reactions, synthesis, mechanism, isolation of natural products, standardization of reaction conditions, new methods etc. External and internal examiners will examine this jointly at the time of practical examination.
5. Any other experiments as may be necessary.  
(Any other suitable experiments may be added)

#### REFERENCES BOOKS

1. A Textbook of Practical Organic Chemistry – A. I. Vogel.
2. Practical Organic Chemistry – Mann & Saunders.
3. A Handbook of Quantitative & Qualitative Analysis- H. T. Clarke.
4. Organic Synthesis Collective Volumes.
5. Organic Reactions (Wiley).

M. Sc. Part II (Physical Chemistry)

Revised Syllabus

SEMESTER- III

PAPERS

PCH-301 : Quantum Chemistry

PCH-302 : Electrochemistry

PCH-303 : Molecular Structure-I

PCH-304(A) : Solid State Chemistry

PCH-304(B) : Advanced Chemical Kinetics

PCH-304( C ) : Radiation and Photochemistry

SEMESTER- IV

PAPERS

PCH-401 : Thermodynamics and Statistical Mechanics

PCH-402 : Chemical Kinetics

PCH-403 : Molecular Structure II

PCH-404(A) : Surface Chemistry

PCH-404(B) : Chemistry of Materials

PCH-404( C ) : Biophysical Chemistry

PRACTICAL COURSE

PAPER NO. PCH- 311 & 312

PAPER NO. PCH- 411 & 412

And Project

## Semester - III

Paper No. PCH-301: Quantum Chemistry

Unit - I: Brief review of failure of classical mechanics. [15]

Wave Particle duality. The dynamics of microscopic systems: the Schrodinger equation, the uncertainty principle, the interpretation of the wave function.

Unit - II: Formalism of Quantum Mechanics: [15]

a) Postulates of Quantum Mechanics , Eigen function and Eigen values

b) Operators

c) Acceptability of wave functions, Normalized and orthogonal wave functions.

d) Principles of superposition , Schnidt Orthogonalisation

e) Hermitian operators ,

f) Theorems related to commutator operations, Stern- Gerlach experiment and spin of electron. Spin eigen function. Concept of angular momentum, angular momentum operators. Ladder operators.

Unit - III: Quantum Mechanics of some simple systems: [15]

a) Practical in a box: One dimensional Box - application to spectra of linear conjugated molecular. Degeneracy in multidimensional box.

b) Potential well of finite depth ( Tunneling effect )

c) Rigid rotator,

d) Linear harmonic oscillator, the formal solutions, energy levels, degeneracy, properties

of wave functions and selection rules.

Unit - IV: The hydrogen Problem: [15]

Schrodinger equation for hydrogen atoms (polar co. ordinates) and its solution. The radial

distribution function and its significance, shape of atom orbitals.

Unit - V: A brief introduction to hydrogen like atoms. [15]

Helium atoms. Approximate methods: Perturbation theory and Self-consistent field theory, chemical bonding and hybridization.

Approximate methods: The variation theorem and principles, its use to obtain optimum molecular orbital and energies.

Unit - VI: Secular equation and secular determinants. [15]

Huckel Molecular Orbital Theory, origin of aromatic stability and calculation of delocalization energy.

Brief introduction to hetero-nuclear systems. Use of symmetry based linear combination to simplify the problem of Huckel theory calculations for larger aromatic molecules.

#### REFERENCE BOOKS

1. Introductory Quantum Chemistry by A. K. Chandra. Tata McGraw-Hill. 1988.
  2. Basic Physical Chemistry by W. J. Moore, Prentice Hall, 1986.
  3. Physical Chemistry, by P. W. Atkins , ELBS, 1986.
  4. Quantum Chemistry, W. Kauzmann, Academic press.
  5. Quantum Chemistry by Hanns.
  6. Theoretical Chemistry by S. Glasstone , Van Nostrand .
  7. Physical Chemistry by Alberty .
  8. Quantum Chemistry by Prasad
  9. Huckel Molecular theory by Keith Yates
- Paper No.PCH-302: Electrochemistry  
Unit - I : Electrolytic conductance: (15)

Debye - Huckel theory of inter-ionic attraction , ionic atmosphere, time of relaxation, relaxation and electro-phoretic effects, Debye-Huckel-Onsagar equation and its validity for dilute solutions and at appreciably concentrated solutions. Debye-Falkenhagen and Wein effects. Abnormal ionic conductance of hydroxyl and hydrogen ions.

Activity coefficients: forms of activity coefficients and their interrelationship.

Debye-Huckel limiting law its applications to concentrated solutions. Debye-Huckel Bronsted equations. Quantitative and qualitative verification of Debye-Huckel limiting law, ion association. Bjerrum theory

Unit - II : Ion solvent interactions and electrolysis: (15)

The Born Model and expression for the free energy of ion- solvent interactions.

Thermodynamic parameters for the ion - solvent interactions. Calculations of heats

of hydration of ions and the concept of hydration number .

Electrolysis: Decomposition potentials: calculations and determinations.

Polarization: types of polarization, over voltage and hydrogen and oxygen over voltage.

Unit - III: Electrode reactions. (15)

Tafel equations, kinetics of discharge of hydrogen ions . Diffusion over potentials.

Fuel cells: significance of fuel cells: hydrogen - oxygen, hydrocarbon - air, natural gas and carbon monoxide, air fuel cells.

Corrosion: concept and importance, mechanism of corrosion and Pourbaix diagrams.

UNIT-IV [15]

Electrokinetic phenomena: Electrical double layer, theories of double layer, electro-capillary phenomena, electro-capillary curve. Electro-osmosis, electrophoreses. Streaming and Sedimentation potentials. Zeta potentials and its determination by electrophoresis, influence of ions on Zeta potential.

REFERENCE BOOKS

1. An Introduction to Electrochemistry by S. Glasstone
2. Modern Electrochemistry Vol. I & II by J. O. M. Bockris and A.K.N. Reddy .
3. Physical Chemistry by S. Glasstone
4. Electrolytic Solutions by R. A. Robinson and R. H. Stokes
5. Physical Chemistry by P. W. Atkins. ELBS.

Paper No. PCH- 303: Molecular Structure - I

Unit - I: Symmetry properties of molecules and group theory: (15)

Symmetry elements, symmetry operations and point groups, properties of group, symmetry operations as a group, multiplication table. Classes of symmetry operations, basis, representative and matrix representations of operations.

Reducible and irreducible representations, orthogonality theorem. Properties of irreducible representations. Constructions of character table for point groups.

Explanations for the complete character table for a point group. Representations of vibrational modes in nonlinear molecules. Infrared and Raman activities of normal modes of vibrations.

Unit - II: Introduction of spectroscopy and Rotational Spectra : (15)

Characterization of electromagnetic radiation. The quantification of energy.

Regions of Spectrum, transition probability, the width and intensity of spectral transitions.

Classification of molecules according to their moment of inertia. Rotational spectra of rigid and nonrigid diatomic molecules. The intensities of spectral lines. The effect of isotopic substitution. Polyatomic and symmetric top molecules. The Stark effect.

Unit- III Infrared spectroscopy and Raman Spectroscopy: (15)

Diatom molecules : 1) Molecules as harmonic oscillator, Morse potential energy function, vibrational spectrum, fundamental vibrational frequencies. Force constant, zero point energy, isotope effect. The Anharmonic oscillator, the diatomic vibrating rotator, the interactions of rotations and vibrations.

Polyatomic molecules: Fundamental vibrations and their symmetry, overtone and combination frequencies. The influence of rotations and molecular spin on the spectra of polyatomic molecules. Analysis by Infrared techniques.

Raman Spectroscopy : Rayleigh scattering . Raman Scattering, classical and quantum theories of Raman effect. Rotational Raman Spectra for linear and symmetric top molecules. Vibrational Raman Spectra , rotational fine structure. Polarization of light and the Raman effect . Structure determination from Raman and Infra-red spectroscopy.

Unit - IV Electronic Spectroscopy : (15)

General nature of band spectra. Beer- Lambert Law integrated absorption coefficient and oscillator strength. Term symbols for atoms and molecules. The hydrogen atom and hydrogen like species spectrum.



Sequences and progressions, the vibrational course structure and rotational fine structure of electronic band. The Franck-Condon principle, dissociation energy and dissociation products. Birge-Sponer extrapolation. The Fortrat diagram. Predissociation, classification of electronic states. The spectrum of molecular hydrogen. Electronic spectra of polyatomic molecules. Chemical analysis by electronic spectroscopy. (d-d), ( $\pi \rightarrow \pi^*$ ) and ( $n \rightarrow \pi^*$ ) transitions. Photochemical mechanism of vision.

#### REFERENCE BOOKS

1. Fundamental of molecular spectroscopy by C. N. Banwell Tata McGraw Hill.
2. Physical Chemistry by P. W. Atkins , ELBS, 1986
3. Symmetry, Orbitals and spectra by M. Orchin & H. Jaffe, Willey , interscience.
4. Chemical applications of group theory by F. A. Cotton Willey , interscience
5. Symmetry in chemistry by H. Jaffe and M . Orchin , Jhon willey.
6. Group theory and its applications to chemistry by K. V. Ramen , Tata McGraw Hill.
7. Molecular Structure and Molecular Spectra by G. Herzberg, Van Nostrand .
8. Molecular Spectroscopy by I. N. Levine , Willey interscience.
9. Molecular Spectroscopy by G. M. Barrow.

PAPER: PCH-304 (A): Solid State Chemistry (elective)

Unit I: The solid state : (15)

Types of solids, isomorphism and polymorphism, laws of crystallography, lattice types, X-ray diffraction, Bragg's equation, Miller indices, Bragg Method, Debye-Scherrer method of X-ray structure analysis of crystals, indexing of reflections, identification of unit cells from systematic absence in diffraction pattern, structure of simple lattice and X-Ray intensities, structure factor and its relation to intensity and electron density, phase problem, procedure for an X-ray structure determination.

Unit II: Solid State Reactions: (15)

General principle, types of reactions: Additive, structure sensitive, decomposition and phase transition reactions, tarnish reactions, kinetics of solid state reactions, factors affecting the reactivity of solid state reactions.

Unit III: Electronic Properties and Band Theory: (15)

Metals, insulators and semi conductors, free electron theory and its applications, electronic structure of solids, band theory, band structure of metals, insulator, and

semiconductors, doping in semiconductors, p- n junction, super conductors, optical properties, photo-conduction and photoelectric effects, laser action, solid state laser and their applications.

Unit IV: Preparation of materials: (15)

Purification and crystal growth, zone refining, growth from solution, growth from melt and preparation of organic semiconductors for device applications.

#### REFERENCE BOOKS

1. A guide to laser in chemistry by Gerald R., Van Hecke, Keny K. Karokitis
2. Principals of solid state, H. V. Keer, Wiley Eastern,
3. Solid state chemistry, N. B. Hannay
4. Solid state chemistry , D. K. Chakrabarty , New Age International
5. An Introduction to Crystallography : F. G. Philips
6. Crystal Structure Analysis: M. J. Buerger
7. The Structure and properties of materials:  
Vol. III Electronic properties by John Walss
8. Electronic processes in materials : L. U. Azroff and J. J. Brophy
9. Chemistry of imperfect crystal : F. A. Krogen
10. Elements of X-ray Diffraction by B. D. Cullity, Addison- Weily.
11. Solid state Chemistry by A.R.West (Plenum)
12. Electronics made simple by Jacobwitz.

Paper : PCH : 304 B : Advanced Chemical Kinetics(Elective)

Unit-I: Hydrogen ion dependence of reaction rates: (15)

Protonation and hydrolysis equilibria, determination of active reactant species from kinetic data, interpretation of hydrogen ion effect with example.

Unit-II: Electron transfer reaction: (15)

Complimentary and non-complimentary reactions, outer and inner-sphere electron

transfer reactions, proton transfer, hydride transfer and hydrogen, oxygen and chlorine atom transfer reactions.

Unit-III: Catalysis: (15)

Trace metal ion catalysis and their mechanisms. Micellar catalysis, Berezini, Menger-Portonoy, cooperative and pseudo-phase ion exchange models and examples.

Unit-IV: Mechanism of chromium(VI) oxidations: (15)

One and two equivalent reductants oxidation, assumptions, limiting forms of rate laws, Westheimer mechanism and its validity. Catalysis, Induced and cooxidations. Mechanisms other than Westheimer mechanism.

#### REFERENCE BOOKS AND ARTICLES

- 1) Chemical Kinetics by K. J. Laidler.
- 2) Kinetics and Mechanism by A. A. Frost and R. G. Pearson
- 3) Micellar effect on the kinetics and mechanism of chromium(VI) oxidation of organic substrates By Asim K. Das, Coordination Chemistry Reviews, Vol 248, p 81-89 ( 2004 ).
- 4) Some aspects of electron transfer reactions involving organic molecules by B. Sethuram, Allied Publishers, 2003.
- 5) Surfactants and polymers in aqueous solution by Bo Jonsson, Bjorn Lindman, Krister Holmberg and Bengt Kronberg, John-Wiley & Sons, 1998.
- 6) Inorganic reaction mechanisms, Part II Edited by John O. Edwards, Interscience, 1972.

Paper : PCH : 304 C : Radiation and Photochemistry(Elective)

Unit - I : Radiation Chemistry : (15)

Introduction, Radiation Types, their characteristics, Radiation in chemical processes.

Unit - II: Lasers and Lasers in Chemistry : (15)

Introduction, characteristics of laser, uses of lasers in chemical process, laser induced chemical reactions, organic photochemistry, lasers as a photochemical tool, laser induced selective bond chemistry , overview , bond selective chemistry of light atom molecules.

Unit - III: Basics of photochemistry : (15)

Electrochemistry of excited states , life time measurements , flash photolysis, energy dissipation by radiative and non-radiative processes, properties of excited states, structure , dipole moment, acid-base strength, reactivity , photochemical kinetics, calculations of rates of radiative process , bimolecular quenching, Luminescence for sensors and switches , charge transfer excited state, photoinduced electron transfer reactions.

Unit - IV : Miscellaneous Photochemical reaction : (15)

Photo-fries reaction of anilides , photo - fries rearrangement, Barton reaction , singlet molecular oxygen reactions , photochemical formation of smog , photodegradation of polymers , photochemistry of vision .

#### REFERENCE BOOKS

- 1) Molecular Photochemistry , N. J. Turro, W.A. Benjamin
- 2) Fundamentals of Photochemistry , K. K. Rohatagi - Mukherji, Wiley - Eastern
- 3) Elements of Inorganic Photochemistry : G. S. Ferraudi , Wiley
- 4) Concepts of Inorganic Photochemistry , A.W. Adamson & P. J. Fleischauer , Wiley
- 5) A Guide To lasers in chemistry , Gerald R. Van Hecke & Kerry K. Karukstis.
- 6) Photochemistry , R.P. Kundall, A Gilbert, Thomson Nelson

#### PARCTICAL COURSE

Paper No. PCH- 311 & 312

Potentiometry

1. To determine instability constant & stoichiometry of silver ammonia complex potentiometrically.
2. Determination of Thermodynamic Parameters for electrochemical reactions.  
(To determine  $\Delta G^\circ$ ,  $\Delta H^\circ$ , and  $\Delta S^\circ$  for the formation of 1 mole cadmium in 1 wt. % amalgam at 25°C and activity coefficient of solution).

Spectrophotometry

- 1) To determine pK value of methyl red indicator at room temperature spectrophotometrically
- 2) To determine stoichiometry & stability constant of ferric Sulphosalicylic acid/ salicylic acid complex by Job's Method and mole ratio method spectrophotometrically.
- 3) To determine equilibrium constant of reaction  $KI + I_2 \rightleftharpoons KI_3$  spectrophotometrically

Amperometry

To determine unknown concentration of Iodine using amperometry

Chemical Kinetics

To determine the order of reaction between acetone and iodine catalyzed by acid.

Conductometry

To determine equivalent conductance at infinite dilution of strong electrolytes and weak acid by using Kohlrausch Law and dissociation constant for weak acid conductometrically.

Cryoscopy

To determine molecular weight and state of benzoic acid in benzene.

Moving boundary Method

To determine transport of H<sup>+</sup> ions by using Moving boundary method.

pH - Metry

To determine dissociation constant of carbonic acid pH metrically.

Polarography

To determine half wave potential of a given ion using half height method,  
differential method and wave equation method

Latent heat of Fusion

Determination of latent heat of fusion of a given solid.

Thermochemistry

Determination of heats of dilution and integral heat of solutions.

Semester - IV

Paper-PCH-401:Statistical Mechanics and Thermodynamics

Unit - I :Modern Theoretical principals : (15)

Exact and inexact differential expressions in two variables. Total differentials.

Techniques of partial differentiations. Transformation of variables. Maxima and minima . Integrating factors, Paff differential equations, Caratheodorys theory.

Legendre transformations. Derivation of thermodynamic identities . The second law of thermodynamics, classical formulations, mathematical consequences of second law. Entropy changes , Clausius inequality . free energy concept.

General

condition of equilibrium. Thermodynamic potentials.

Unit - II:Phase space, stirlings appronimation : (15)

Configuration and weights, the most probable configuration. Statistical Equilibrium. Postulates of equal probabilities. Ensembles. Ensemble average and time average of property.

The Boltzmann Distribution law. Principle of the equipartition of energy ,

Quantum Statistics : BE and FD statistics, Comparison of three statistics, comparison of three statistics and radiation , Fermi - Dirac systems. Fermi energy.

Electron gas in metals.

Unit - III : Molecular partition function: (15)

Expressions for transnational, rotational, vibrational and electronic partition functions, relation between the partition function and thermodynamic properties,

rotational contribution to entropy. Free energy functions, ortho and para hydrogen,

use of spectroscopic and structural data to calculate thermodynamics functions.

Molecular and statistical interpretation of entropy, third law of thermodynamics and equilibrium constant.

Heat capacity of solids, Einstein and Debye specific heat equations.

Characteristic

temperature.

Unit - IV: Thermodynamics of irreversible processes. (15)

Conversion of mass in closed and open systems . conservation of energy in closed

and open systems . Law of increasing entropy. Non - adiabatic process and clausius inequality, steady state. Thermodynamic equations of motion.

Generalized fluxes. Forces and their transformation. Phenomenological equations

and coefficients . concepts of reciprocity relations and Onsager theorem of microscopic reversibilities.

Entropy production in closed and open systems. Entropy production due to heat flow. Chemical potentials. Diffusion, electromotive force and other reactions involving cross relations. Saxens relations. Oscillatory reactions.

#### RECOMMENDED BOOKS

1) Elements of statistical thermodynamics - L. K. Nash, Addison Wesley

2) Statistical thermodynamics by B. J. McClland, Chapman and Hall.

3) A Introduction to Statistical Thermodynamics by T. L. Hall

Addison - Wesley

4) Thermodynamics of Irreversible Processes by Ilya Prigofine.

5) Thermodynamics of steady state by Denbeigh

6) Advanced physical Chemistry by S. N. Blinder, The Macmillan Company, 1967.

7) Thermodynamics by R. C. Srivatsava, S. Saha and A. K. Jain, Prentice-hall, India.

8) Theoretical Chemistry by S. Glasstone.

Paper No.PCH- 402 : Chemical Kinetics

Unit - I :Chemical kinetics: (15)

Steady State Approximation Collision theory of gas reaction , collision frequency.

The rate constant , molecular diameters , collision theory vs. experiment

Kinetics of Fast reactions: Relaxation techniques, pressure jump and temperature

jump methods, NMR relaxation, flash photolysis and molecular beam methods.

Unit - II : Theories of reaction rates: (15)

Activated complex theory of reaction rates, reaction coordinate and transition state, formation and decay of activated complex, Eyring equation, thermodynamic

aspects

Theory of unimolecular reactions.

Unit - III: Reactions in solution: (15 )

Oxidation –reduction reactions: One-electron & two-electron transfer reactions.

Inner sphere & outer-sphere reactions, complementary two equivalent changes

(  $Tl^+ - Tl^{3+}$  exchange). Unstable oxidation states. Tests for Marcus Hush theory.

Unit- IV: organic reaction mechanisms: (15 )

Linear free energy relationships: Hammett Plots, Hammett equation, substituent and

reaction constants and their physical significance, calculation of  $k$  and  $K$  values, Yukawa-Tsuno equation.

Taft equation, steric parameters

Solvent effects, Grunwald-Winstein equation.

REFERENCE BOOKS



- 1) Chemical Kinetics by K. J. Laidler.
- 2) Kinetics and Mechanism by A. A. Frost and R. G. Pearson.
- 3) Fast Reactions by Haque.
- 4) Theory of chemical reaction rates by K. J. Laidler, McGraw Hill, New York , 1969.
- 5) Fast Reactions by J. N. Bradley , Clarendon Press Oxford , 1974
- 6) Physical Chemistry by W. J. Moore.
- 7) Physical Chemistry by P.W. Atkins
- 8) Mechanism of Inorganic Reactions by F. Basolo and R. G. Pearson, John Wiley & Sons Inc., 2<sup>nd</sup> Edition, 1967.
- 9) A Guidebook to Mechanism in Organic Chemistry, Peter Sykes, Orient Longmann, 6<sup>th</sup> Edition, 2003.

Paper No. PCH-403: Molecular Structure - II

Unit - I: The Electric Properties of Molecules: (15)

Electric dipole moment of molecule, polarization of a dielectric , polarizability of molecules, Clausius-Mossotti equation. Debye equation . limitation of the Debye theory , determination of dipole moment from dielectric measurements in pure liquids and in solutions. Dipole moment and ionic character, Bond moment, Group moment, vector addition of moments, bond angles, The energies due to dipole-dipole, dipole induced dipole and induced dipole-induced dipole interaction. Lennard-Jones potential .

Unit - II: The Magnetic properties of Molecules: (15)

Diamagnetism and paramagnetism. Volume and mass susceptibilities. Langevin's classical theory of diamagnetism and paramagnetism Atomic and ionic susceptibility. Pascal constants , Curie - Weiss law . Van Vleck general equation

of magnetic susceptibility. Determination of magnetic susceptibility. Ferro and ferri magnetism, application to coordination complexes and complex ions of transition metals.

Unit - III: Nuclear Magnetic Resonance Spectroscopy: (15)

The nature of spinning particles, interaction between spin and a magnetic field. Population of energy levels, The Larmor precession. relaxation times. the meaning of resonance and the resonance condition. NMR experiment, significance of shielding constants and chemical shift. the origin and effect spin

-

spin coupling, factors affecting chemical shift, chemical analysis by NMR.

Exchange phenomena,  $^{13}\text{C}$  NMR spectroscopy, double resonance and nuclear Overhauser

effect.

Unit - IV: [15]

a) Electron Spin Resonance Spectroscopy:

(8)

Electron spin and Magnetic moment, Resonance condition in ESR and significance of 'g' value. ESR spectra of organic free radicals, McConnell relation, Electron Exchange reactions, applications of ESR,

b) Mossbauer Spectroscopy:

Basic principle of Mossbauer spectroscopy, hyperfine structure, quadrupole splitting, instrumentation and applications of Mossbauer spectroscopy, Problems related to Mossbauer spectra.

#### REFERENCE BOOKS

1. Fundamentals of molecular spectroscopy by C. N. Banwell.
2. Physical chemistry by P. W. Atkins. ELBS. 1986
3. Introduction to molecular spectroscopy by G. M. Barrow.
4. Molecular spectroscopy by I. N. Levine, Wiley Interscience.
5. Nuclear magnetic Resonance by J. D. Roberts, McGraw Hill.

6. Introduction to Magnetic resonance by A. Carrington and A. D. McLachlan. Harper and Row.
7. Electron Spin Resonance , Elementary theory and practical applications by J. E. Wetz and J. R. Boulton , McGraw Hill .
8. Introduction to Magnetochemistry by Earnst Shaw. Academic Press
9. Electrical and optical properties of molecular behavior by M. Davies, Pergamon press.
10. Polar molecules by P. Debye , Dover publications.

Paper No. PCH - 404 A: Surface chemistry (Elective)

Unit I: Adsorption and surface phenomenon: (15)

Physisorption and chemisorption , adsorption isotherms, Langmuir and B. E. T. equation and significance in surface area determination, surface films, states of insoluble films, L. B. films and their application, adsorption from solution, adsorption types, surface excess concentration , Gibb's adsorption equation : derivation , significance and experimental verification , catalytic activity of surfaces.

Unit II: Micelle: (15)

Surface activity, surface active agents and their classification, micellisation, critical micelle concentration ( cmc) thermodynamics of micellisation , factors affecting cmc, methods of determination of cmc , reverse micelle , solubilisation of water insoluble organic substances , use of surfactants in oil recovery ,

Unit III: Emulsion:

(8)

Types of emulsion, theories of emulsion and emulsion stability, identification of emulsion types, inversion emulsion, microemulsion : theory and application ,

Unit IV: Liquid gas and liquid interfaces: (15)

Surface tension, capillary action, methods of determination of surface tension,

surface tension across curved surfaces, vapor pressure of droplet ( Kelvin equation

) , surface spreading , spreading coefficient, cohesion and adhesion energy, contact angle, constant angle hystereis, wetting and detergency.

Unit V : Solid - Solid interfaces : (15)

Surface energy of solids, adhesion and adsorption, sintering and sintering mechanism, Tammann temperature and its importance, surface structure and surface composition.

#### REFFERNCE BOOKS

1. Physical chemistry of surfaces: A. W. Adamson.
2. Theory of adsorption and catalysis by Alfred Clark ,
3. Chemisorption by B. M. W. Trapnell and H.O. Hayward.
4. Introduction to colloide and surface chemistry by D. J. Shaw.
5. Theories of chemical reaction rates by A. J. K. laidler
6. Surface chemistry by J. J. Bikermann

Paper No.PCH- 404 ( B): Chemistry of materials (Elective)

Unit I: Glasses, Ceramics, Composite and Nanomaterials: (15)

Glassy state, glass formers and glass modifiers, applications, Ceramic structures,

mechanical properties, clay products. Reformatories, characterizations, properties

and applications.

Microscopic composites; dispersion - strengthened and particle - reinforced, fibre

-

reinforced composites, macroscopic composites. Nanocrystline phase, preparation

procedures, special properties, and applications.

## Unit II: High T<sub>c</sub> Materials: (15)

Defect perovskites, high T<sub>c</sub> superconductivity in cuprates, preparation and characterization of 1-2-3 and 2-1-4 materials, and normal state properties; anisotropy; temperature dependence of electrical resistance; optical phonon modes,

superconducting state; heat capacity; coherence length, elastic constants, position

lifetimes, microwave absorption - pairing and multigap structure in high T<sub>c</sub> materials, applications of high T<sub>c</sub> materials.

## Unit III: Polymeric Materials: (15)

Molecular shape, structure and configuration, crystallinity, stress-strain behavior,

thermal behavior, polymer types and their applications, conducting and ferro-electric polymers.

## Unit IV: (15)

### a) Thin films and Langmuir-Blodgett Films: [7]

Preparation techniques; evaporation / sputtering, chemical processes, MOCVD, sol-gel etc. Langmuir-Blodgett (LB) film, growth techniques, photolithography, properties and application of thin and LB films.

### b) Materials of Solid Devices: (8)

Rectifiers, transistors, capacitors IV-V compounds, low dimensional quantum structure; optical properties.

## REFERENCE BOOKS

1. Solid State Physics, N. W. Ashcroft and N. D. Mermin, Saunders College
2. Material Science and Engineering, An introduction, W. D. Callister, Willey.
3. Principles of Solid State, H. V. Keer, Willey Easton.
4. Materials Science, J. C. Anderson, K. D. Leaver, J. M. Alexander and R. D. Rawlings, ELBS

5. Thermotropic Liquid Crystals, Ed, G. W. Gray, John Willey.
6. Text book of liquid crystals, Kelkar and Halz , Chemie Verlag

Paper No :PCH- 404 C: Biophysical Chemistry (Elective)

Unit - I Chemistry and Biology : (15)

Amino acids , proteins , enzymes , DNA & RNA in living systems , electrolytes, the chirality of biological molecules , the biochemical process , weak and strong interactions, macromolecules and rubber elasticity , polyelectrolytes , biopolymers.

Unit - II Physical aspects of biopolymers: (15)

X-ray diffraction, electronic absorption & luminescence Spectroscopy, optical activity , magnetic activity , magnetic-optical activity. Osmosis, hydrophobic hydration and interactions. The properties of amino acids and their aqueous solutions.

Unit - III Photo biological Process : (15)

Photosynthesis , mechanism of vision , the molecular mechanism of photoreceptor

.

Unit - IV : Mechano-chemical processes : (15)

Introduction, thermodynamics, nerve conduction and membrane equilibria, muscle

and muscle proteins, their chemistry and physics , kinetic properties of muscle, mechano- chemical systems , biomachanics.

#### REFERENCE BOOKS

- 1) Biophysics by M.V. Volhenshfein.
- 2) Natural products : Chemistry & Biological Significance , J. Mann , R.S. Davidson, J. B. Hobb's , D. V. Banthrope and J. B. Harborne , Longmar Essex
- 3) Elements of Inorganic Photochemistry , G. J. Ferrandi , wiley

4) Principles of bioinorganic chemistry , S. J. Lippard and J. M. Berg , University Science Books,

5) Principles of biochemistry , A. L. Lehninger, worth publisher

6) Biochemistry , J. David Rawn , Neil Patterson

7) Hydrophobic interactions by Ben-Naim, Plenum.

#### PARCTICAL COURSE

Paper No. PCH- 411 & 412

Spectroscopy:

1) Characterization of the complexes by electronic and IR spectral data.

2) Determination of indicator constant and isobestic point of an indicator.

3) Determination of stability constant of ferric thiocyanate complex.

Potentiometry:

Determination of  $E_0$  value of Ag / AgI electrode and solubility product of AgI and  $PbI_2$ .

Conductometry:

1) Kinetic study of hydrolysis of ethyl acetate in presence of  $OH^-$  ions.

2) Determination of the critical micelle concentration of sodium lauryl sulphate in aqueous solution.

pH - Metry:

Determination of acid - base dissociation constants of an amino acids.

Polarography:

Determination of unknown concentration of  $Cd^{+2}$  /  $Zn^{+2}$  ion in the given solution by standard addition method.

Fluorimetry:

Estimation of quinine as quinine sulfate from medicinal tablets.

Cryoscopy:

Determination of mean activity coefficient of sulfate by freezing point depression method.

Kinetics:

Study of the effect of ionic strength on the reaction between persulphate and iodide by visual method.

Thermometry:

Determination of normality of given HCl & CuSO<sub>4</sub> by thermometric titration.  
And project work