GONDWANA UNIVERSITY, GADCHIROLI

M.Sc.-I Semester I, II (Chemistry)

(Effective from 2016-17)

1. There will be four theory papers in every semester which will carry 80 marks each of 3 hrs. duration.

2. There will be internal assessment of 20 marks per paper per semester.

3. Each paper per semester with total of 100 marks(80+20 i.e. theory+internal assessment) will carry 4 credits.

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

5. There will be two practical examinations in each semester i.e. Pract I and Pract II of 6-8 hours duration of 80 marks with 4 credits each.

6. In each semester, the student will have to deliver a seminar on any topic relevant to the syllabus / subject encompassing the recent trends and development in that field / subject. This will carry 25 marks per seminar with one credit.

7. So, the total marks allotted to the Chemistry subject per semester is 625 marks: Theory (320 marks) + Internal assessment (120 marks) + Practicals (160 Marks)+ Seminar (25Marks)= 625marks (total)

8. Each theory paper consists of four units of fifteen hours per unit.

The following syllabi are prescribed on the basis of four hours per week of each paper and nine practical periods per batch per week.

Scheme of Examination for M.Sc. (Chemistry)

Semester I	Internal Assessment	Total Marks	Credits
PSCChT01: Paper I (Inorganic Chemistry)	20 Marks	80 Marks	4 Credits
PSCChT02: Paper II (Organic Chemistry)	20 Marks	80 Marks	4 Credits
PSCChT03: Paper III (Physical Chemistry)	20 Marks	80 Marks	4 Credits
PSCChT04: Paper IV (Analytical Chemistry)	20 Marks	80 Marks	4 Credits
PSCChP01: Practical-I (Inorganic Chemistry)	20 Marks	80 Marks	4 Credits
PSCChP02: Practical-II (Organic Chemistry)	20 Marks	80Marks	4 Credits
PSCChP03: Seminar-I	---- --	25 Marks	1 Credits
Total:	**120 Marks**	**505 Marks**	**25 Credits**

Semester II			
PSCChT05: Paper V (Inorganic Chemistry)	20 Marks	80 Marks	4 Credits
PSCChT06: Paper VI (Organic Chemistry)	20 Marks	80 Marks	4 Credits
PSCChT07: Paper VII (Physical Chemistry)	20 Marks	80 Marks	4 Credits
PSCChT08: Paper VIII (Analytical Chemistry)	20 Marks	80 Marks	4 Credits
PSCChP04: Practical-III (Physical Chemistry)	20 Marks	80 Marks	4 Credits
PSCChP05: Practical-IV (Analytical Chemistry)	20 Marks	80 Marks	4 Credits
PSCChP06: Seminar-II	----	25 Marks	1 Credits
Total:	**120 Marks**	**505Marks**	**25 Credits**

General scheme for distribution of marks in practical examination

Time : 6-8 h (One day Examination) Total Marks : 80)
Exercise-1 - 30 Marks
Exercise-2 - 20 Marks
Viva-Voce -15Marks
Record -15 Marks

Question Paper Pattern: Each paper comprising of Max marks 80 of 3 hours duration

Que.-1 (From Unit I) – (A-8 Marks + B-8 Marks) = 16 Marks or (a-4 + b-4 + c-4 + d-4) = 16 Marks

Que.-2 (From Unit II) – (A-8 Marks + B-8 Marks) = 16 Marks or (a-4 + b-4 + c-4 + d-4) = 16Marks

Que.-3 (From Unit III) – (A-8 Marks + B-8 Marks) = 16 Marks or (a-4 + b-4 + c-4 + d-4) = 16Marks

Que.-4 (From Unit IV) – (A-8 Marks + B-8 Marks) = 16 Marks or (a-4 + b-4 + c-4 + d-4) = 16Marks

Que.-5 Short answer question each carry two marks (2 short questions from each unit)= 16 marks

Total: 80 marks

Syllabus prescribed for M.Sc. Chemistry Semester I

PSCChT01: Paper I (Inorganic Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I

A) **Stereochemistry and Bonding in Main Group Compound**: **5h**

VSEPER-Shape of simple inorganic molecules and ions containing lone pairs, various stereo chemical rules and resultant geometry of the compounds of non-transitional elements, short comings of VSEPR model. Bent's rule and energetics of hybridization.

B**) Metal – Ligand Bonding**: **10h**

Crystal Field Theory: Splitting of d-orbital in tetragonal, square planar and trigonal bipyramid complexes. John teller effect, spectrochemical series, nephelauxetic effect. Limitaion of crystal field theory. M.O.theory for octahedral, tetrahedral & square planar complexes with and without π-bonding.

Unit-II

A) **Metal – Ligand Equilibria in Solution**: **5h**

Stepwise and overall formation constants; trends in stepwise formation constants; factors affecting stability of metal complexes with reference to nature of metal ion, ligand, chelate effect and thermodyanamic origin. Determination of formation constant by : (1)spectrophotometric method (Job's and Mole ratio method) (2) Potentiometric method (Irving-Rossotti Method) B) Reaction Mechanism of Transition metal complexes: 10h

Energy Profile of a reaction, reactivity of metal complexes, Inert and Labile complexes, Kinetics of Octahedral substitution: Acid hydrolysis, factors affecting acid hydrolysis, Stereochmistry of intermidiates in SN1 & SN2 , Base hydrolysis, Conjugate base mechanism, Direct and indirect evidences in favour of conjugate mechanism, Annation reaction, reaction without metal-ligand bond breaking.

Unit-III:

Cluster- I 15h

Boron hydrides: Classification, nomenclature, structure, bonding and topology of boranes, 4-digit coding (s, t, y, x) numbers for higher boranes and their utilities. Chemistry of

diboranes: Study of Metalloboranes, Carboranes and Metallocarboranes with reference to preparations and structures.

Unit – IV

A**) Metal-Metal bonds: 10h**

Occurrence of metal-metal bond, Classification of metal clusters, Binuclear, trinuclear, tetranuclear, pentanuclear and hexanuclear with reference to halide, oxide, alkoxide and acetate clusters.

B) **Isopoly, Heteropoly acids and their anions. 5h**

List of Books

1) S. F. A. Kettle, J. N. Murral and S. T. Teddler: Valency Theory

2) C. A. Coulson: Valency

3) J. E. Huheey :Inorganic Chemistry

4) F .A. Cottonand G. Wilkinson: Advanced Inorganic Chemistry 3rd, 5thand 6th Editions.

5) A. F. Willims: Theoretical Approach in inorganic chemistry.

6) A. Mannas Chanda: Atomic Structure and chemical Bonding

7) L. E. Orgel: An Introduction To transition metal chemistry, Ligand field theory, 2nd Ed.

8) J. J. Logowski: Modern Inorganic Chemistry

9) B.Durrant and P.J.Durrant: Advanced Inorganic Chemistry

10) J. C. Bailar: Chemistry of coordination compounds.

11) W. L. Jolly: Modern Inorganic Chemistry

12) R. S. Drago: Physical methods in inorganic chemistry.

13) Waddington: Nonaqueous solvents.

14) Sisler: Chemistry of nonaqueous solvents.

15) A. K. Barnard: Theoretical Inorganic Chemistry

16) Emeleus and Sharpe: Modern Aspect of Inorganic Chemistry.

17) F. A. Cotton: Chemical Applications of Group theory.

18) Jones: Elementary Coordination chemistry.

19) B. N. Figgis: Introduction to Ligand field.

20) S. F. A. Kettle: Coordination chemistry.

21) M.C.Day and J.Selbin: Theoretical Inorganic Chemistry.

22) J. Lewin and Wilkins: Modern Coordination Chemistry.
23) Gowarikar, Vishwanathan and Sheedar: Polymer science.
24) H. H. Jattey and M. Orchin: Symmetry in chemistry.
25) D. Schonaland: Molecular Symmetry in chemistry.
26) L. H. Hall: Group theory and Symmetry in chemistry
27) H. H. Jattey and M. Orchin: Symmetry in chemistry
28) R.L.Dutta and A.Symal: Elements of magneto chemistry
29) Inorganic Chemistry 4th Edition, P.Atkins, Oxford University Press.
30) Essential Trends in Inorganic Chemistry, D.M.P.Mingos, Oxford University Press

PSCChT02: Paper II (Organic Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: 15 h

A] **Nature and Bonding in Organic Molecule**

Delocalized chemical bonding, conjugation, cross conjugation, resonance, hyper-conjugation, bonding in fullerenes. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons Huckel's rule, energy level of π-molecules orbitals, annulenes, antiaromaticity, homoaromoaticity. Aromatic character and chemistry of cyclopentadienyl anion, tropylium cation, tropone and tropolone. Bonds weaker than covalent-addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes

B] Synthetic applications of enamines and imines anions in organic synthesis, phase transfer catalysis, crown ethers and graphene.

Unit-II: 15 h

A] **Streochemistry**

Conformational analysis of cycloalkanes (5 – 8 membered rings), substituted cyclohexanes , mono substituted, disubstituted and trisubstituted cyclohexanes, decalines, effect of conformation on reactivity, Cahn-Ingold-Prelog System to describe configuration at chiral centers . Elements of symmetry, chirality, molecules with more than one chiral center, meso compounds, threo and erythro isomers, method of resolution, optical purity, enantiotopic and distereotopic atoms, groups and faces, prochirality, addition-elimination reactions, stereospecific and steroselective synthesis. Asymmetrical synthesis, optical activity in absence of chiral carbon (biphenyl and allenes)

B] **Reactive Intermediates**

Generation, structure, stability and chemical reactions involving classical and non-classical carbocations, carbanions, free radical, carbenes, nitrenes and arynes. Singlet oxygen, it's generation and reactions with organic substrates.

Unit-III: 15 h

A] **Reaction mechanism: Structure and Reactivity**

Types of mechanism, Types of reaction, thermodynamics and kinetics requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammeett principle, Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects. Hard and soft acids and bases.

Effect of Structure on reactivity: Resonance and field effects, Steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft Equation.

B] Concept of neighboring group participation (anchimeric assistance) with mechanism, neighboring group participation by π and σ bonds, classical and non classical carbocations, Intramolecular displacement by hydrogen, oxygen, nitrogen, sulphur and halogen. Alkyl, cycloalkyl, aryl participation, participation in bicyclic system, migartory aptitude, carbocation rearrangements and related rearrangements in neighboring group participation.

Unit IV: 15h

A] **Aliphatic nucleophilic substitution**

The SN1, SN2, mixed SN1, SN2 and SET and SNi mechanisms. Nucleophilicty, effect of leaving group, ambient nucleophiles and ambient substrates regiospecificity, substitution at allylic and vinylic carbon atoms.

B] **Aromatic electrophilic substitution**

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The o/p ratio, ipsoattack, orientation in benzene ring with more than one substituents, orientation in other ring system. Diazonium coupling, Vilsmeir reaction, Gatterman-Koch reaction, Pechman reaction, Reimer-Tieman reaction, Diazonium coupling.

C] **Aromatic Nucleophilic Substitution**

A general introduction to different mechanisms of aromatic nucleophilic substitution SNAr, SN1, benzyne and SRN1 mechanisms. Reactivity - effect of substrate structure leaving group and attacking nucleophile. The Von Richter, Sommlet-Hauser and Smiles rearrangements.

List of books

1] Advanced Organic Chemistry –Reaction mechanism and structure. Jerry March, John Wiley

2] Advanced Organic Chemistry- F.A. Carey and R. J. Sunberg, Plenum

3] A Guidebook to Mechanism in Organic Chemistry-Peter Skyes, Longman

4] Structure and Mechanism in Organic Chemistry-C.K. Gold, Cornell University Press

5] Organic Chemistry, R.T. Morrison Boyd. Prentice Hall

6] Modern Organic Chemistry-H.O. House, Benjamin

7] Principal of Organic Chemistry-R.O.C. Norman and J.M. Coxon, Blackie Academic and Professional

8] Reaction Mechanism in Organic Chemistry-S.M. Mukharji and S.P. Singh, Macmilan

9] Stereochemistry of Organic Compounds- D. Nasipuri, New Age International

10] Stereochemistry of Organic Compounds- P. S. Kalsi, New Age International

11] Frontier Orbitals and Organic Chemical Reactions-I. Fleming

12] Orbital Symmetry – R. E. Lehr and A. P. Marchand

13] Reactive Intermediate in Organic Chemistry-N. S. Isaacs

14] Stereochemistry of Carbon Compounds- E. L. Eliel

15] Physical Organic Chemistry-J. Hine

16] Name Reaction in Organic chemistry –Surrey

17] Advanced Organic Chemistry – L. F. Fieser and M. Fieser.

18] Organic Chemistry Vol. I and II - I. L. Finar

19] Modern Organic Chemistry- J.D. Roberts and M. C. Caserio

20] The Search for Organic Reaction Pathways (Longmann), Peter Skyes

21] Organic Chemistry 5th Edition (McGraw Hill), S. H. Pine

22] Organic Chemistry (Willard Grant Press Botcon), John Mcmurry

23] A Textbook of Organic Chemistry- R. K. Bansal New Age International

24] New Trends in Green Chemistry –V. K. Ahluwalia and M. Kidwai, Anamaya publishers

25] Organic Chemistry, J. Clayden, N. Greeves, S. Warren and P. Wothers, Oxford University Press

26] Organic Chemistry, 4th Edition, G Marc Loudon, Oxford University Press

27] Nano Materials 2007, A. K. Bandyopadhyay, New Age International

PSCChT03: Paper III (Physical Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

UNIT I: FORMULATION OF QUANTUM MECHANICS 15h

A] Introduction of quantum mechanics, wave function, acceptability of wave functions, normalized and orthogonal wave functions, operators, properties of operators, eigen functions and eigen values, Hermitian operators, orbital and generalized angular momentum, eigen function and eigen values of angular momentum, postulates of quantum mechanics, (problems on operators, eigen values and average value)

B] Application of Schrodinger wave equation to simple systems: degeneracy in 3-dimensional box, rigid rotator, potential well of finite depth (tunneling effect), simple harmonic oscillator, the Hydrogen atom.

UNIT II: CLASSICAL THEMODYNAMICS 15h

A] Exact and inexact differentials, condition of exactness, Pfaff differential expression, derivation of thermodynamic equation of state, extensive and intensive properties. Homogeneous functions of degree 0 and 1. Maxwell's relations.

B] Third law of thermodynamics, unattainability of absolute zero, calculation of entropy, residual entropy and its application. Varial equation, fugacity, determination of fugacity.

C] Partial molar quantities: Determination of partial molar quantities, chemical potential, escaping tendency, partial molar volume, Gibbs Duhem equation, Gibbs Duhem Mergules equation, reaction potential, Extent of reaction (Xi).

UNIT III: PHASE EQUILIBRIA 15h

Phase rule, calculation of degrees of freedom, reduced phase rule, construction of phase diagram, one component systems: Helium, carbon, two component systems forming solid solutions having congruent and incongruent melting point, partially miscible solid phase, three component systems, graphical presentation, influence of temperature, systems with 1, 2, 3 pairs of partially miscible liquids, transition points, 1st and 2nd order phase transition, lambda line

UNIT IV: CHEMICAL KINETICS 15h

A] Theories of reaction rates: Unimolecular reactions, bimolecular reactions, collision theory, steric factor, temperature effect on reaction rates, Arrhenius equation and its

limitations, activation energy, transition state theory, steady state approximation, Lindeman-Hinshelwood mechanism, RRKM theory

B] Photochemistry: Introduction, quantum yield, photosensitizers, quenching, kinetics of anthrascene reactions, H_2-Br_2 and H_2-I_2 reactions.

C] Catalysis: Acid- base enzymes, enzyme catalysis, Michaelis Menten equation, effect of pH and temperature.

List of books

1. Ira .N. Levine, Quantum Chemistry, 5th edition(2000), Pearson educ., Inc.New Delhi
2. A.K.Chandra, Introductory Quantum Chemistry, 4th edition (1994), Tata Mcgraw Hill, New Delhi.
3. S.K.Dogra, S.Dogra, Physical Chemistry Through Problems.
4. M.W.Hanna, " Quantum Mechanics in Chemistry", Benjamin
5. L. Pualing and E. B. Wilson, Introduction to Quantum Mechanics with Applications to Chemistry, McGraw Hill, New York (1935).
6. R.P.Rastogi R.R. Mishra 6th revised edition An Introduction to Chemical Themodynamics.
7. Principles of Physical Chemistry by Puri, Sharma and Pathania,
8. P.W.Atkins.Physical chemistry. ELBS
9. E.N.Yenemin, " Fundamentals of Chemical Thermodynamics", MIR Publishers.
10. F.W.Sears, " Introdction to Thermodynamics, Kinetic Theory of Gases and statistical mechanics".Addison Wesley
11. G.M.Panchenkov and V.P.Labadev, " Chemical Kinetics and catalysis", MIR Publishing
12. E.A. Moelwyn- Hughes, " Chemical Kinetics and Kinetics of Solutions", Academic
13. K.J.Laidler, Chemical Kinetics, Third Edition (1987), Harper and Row, New York
14. J.Raja Ram and J.C.Kuriacose, Kinetics and Mechanism of Chemical Transformations MacMilllan Indian Ltd., New Delhi (1993)
15. R.K.Prasad," Quantum Chemistry", Wiley.

PSCChT04: Paper IV (Analytical Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit I: Introduction and statistical analysis 15h

Introduction to analytical chemistry: Types of analysis-qualitative and quantitative. Classification of analytical methods- classical and instrumental, basis of their classification with examples. Statistical analysis and validation: Errors in chemical analysis. Classification of errors- systematic and random, additive and proportional, absolute and relative. Accuracy and precision. Mean, median, average deviation and standard deviation. Significant figures and rules to determine significant figures. Calculations involving significant figures. Confidence limit, correlation coefficient and regression analysis. Comparison of methods: F-test and T-test. Rejection of data based on Q-test. Least squares method for deriving calibration graph. Application of Microsoft Excel in statistical analysis (statistical functions and spreadsheets in MS-Excel). Validation of newly developed analytical method. Certifiedreference materials (CRMs). Numerical problems.

Unit II: Separation techniques 15h

Chromatography: Definition and Classification. Techniques used in Paper, Thin Layer and Column chromatography. Applications in qualitative and quantitative analysis.

Ion exchange: Principle and technique. Types of ion exchangers. Ion exchange equilibria. Ion exchange capacity. Effect of complexing ions. Zeolites as ion-exchangers. Applications.

Solvent extraction: Principle and techniques. Distribution ratio and distribution coefficient. Factors affecting extraction efficiency: Ion association complexes, chelation, synergistic extraction, pH. Numericals based on multiple extractions. Role of chelating ligands, crown ethers, calixarenes and cryptands in solvent extraction. Introduction to Solid phase extraction (SPE) and Microwave assisted extraction (MAE). Applications.

Unit III: Classical methods of analysis 15h

Volumetric analysis: General principle. Criteria for reactions used in titrations. Primary standards and secondary standards. Theory of indicators. Types of titrations with examples- Acid-base, precipitation, redox and complexometric. Titration curves for monoprotic and polyprotic acids and bases. Indicators used in various types of titrations. Masking and demasking agents. Gravimetric analysis: General principles and conditions of precipitation. Concepts of solubility,solubility product and precipitation equilibria. Steps

involved in gravimetric analysis. Purity of precipitate: Co-precipitation and post-precipitation. Fractional precipitation. Precipitation from homogeneous solution. Particle size, crystal growth, colloidal state, aging and peptization phenomena. Ignition of precipitates.

Unit IV: Optical methods of analysis-I 15h

Spectrophotometry and Colorimetry: Principle of colorimetry. Beer's law, its verification and deviations.Instrumentation in colorimetry and spectrophotometry (single and double beam). Sensitivity and analytical significance of molar extinction coefficient and λmax. Comparison method, calibration curve method and standard addition method for quantitative estimation. Role of organic ligands in spectrophotometric analysis of metal ions. Ringbom plot and Sandell's sensitivity. Photometric titrations. Determination of pK value of indicator. Simultaneous determination. Composition and stability constant of complex by Job's and mole ratio methods. Derivative spectrophotometry. Numerical problems.

List of books:

1. Quantitative analysis: Day and Underwood (Prentice-Hall of India)
2. Vogel's Text Book of Quantitative Inorganic Analysis-Bassett, Denney, Jeffery and Mendham (ELBS)
3. Analytical Chemistry: Gary D. Christian (Wiley, India).
4. Instrumental Methods of Analysis: Willard, Merrit, Dean, Settle (CBS Publishers, Delhi, 1986)
5. Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)
6. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
7. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
8. Analytical Chemistry: Problems and Solution- S. M. Khopkar (New Age International Publication)
9. Basic Concepts in Analytical Chemistry: S. M. Khopkar (New Age International Publication)
10. Advance Analytical Chemistry: Meites and Thomas: (Mc Graw Hill)
11. An Introduction to Separation Science: L. R. Shyder and C. H. Harvath (Wiley Interscience)
12. Fundamentals of Analytical Chemistry: S. A. Skoog and D. W. West
13. Instrumental Methods of Chemical Analysis: G. W. Ewing

PSCChP01: Practical-I (Inorganic Chemistry)

9 h /week Marks: 80

I. Preparation of Inorganic Complexes and their characterization by:

Elemental analysis and physico-chemical methods (Electronic and IR Spectra, magnetic susceptibility measurements, Thermal analysis and Molar conductance studies).

1. K_3 [Al $(C_2O_4)_3$]$(H_2O)_3$ 2. [VO $(acac)_2$] 3. Na [Cr $(NH_3)_2(SCN)_4$]

4. K_3[Cr$(SCN)_6$]. 5. [Mn $(acac)_3$] 6. K_3 [Fe $(C_2O_4)_3$]

7. Hg [Co $(SCN)_4$] 8. [Co $(Py)_2$ Cl_2] 9. [Cu_2 $(CH_3COO)_4(H_2O)_2$]

10. [Ni $(DMG)_2$] 11.[Ni$(NH_3)_6$]Cl_2 12. [Cu$(NH_3)_4(H_2O)_2$]SO_4

II. Quantitative Analysis:

Separation and determination of two metal ions from the following alloys involving:

Volumetric, Gravimetric and Spectrophotometric methods

i) Copper (II) and Nickel (II)

ii) Copper (II) and Zinc (II)

iii) Nickel (II)—Zinc (II) and

iv) Copper (II)—Iron (III)

III. Qualitative analysis of radicals:

Semi-micro Analysis of inorganic mixture containing four cations out of which two will be rare metal ions such as W, Mo,Se,Ti,Zr,Ce,Th,V and U.(Spot Test for individual cations should be performed)

PSCChP02: Practical-II (Organic Chemistry)

9 h /week Marks: 80

[A] Qualitative Analysis

Separation, purification and identification of the mixture of two organic compounds (binary mixture with two solid, one solid one liquid and two liquids) using chemical methods or physical techniques. Minimum 8-10 mixtures to be analyzed.

Purification of the compounds by crystallization, TLC and chromatographic techniques.

[B] Organic preparations:

Student is expected to carry out minimum of 5-6 two stage organic preparation and 5-6 single stage preparation from the following lists.

[1] Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol.
[2] Benzophenone →benzhydrol
[3] Aldol condensation: Dibenzal acetone from benzaldehyde.
[4] Sandmeyer reaction: p- chlorotoluene from p-toluidine
[5] Cannizzaro reaction
[6] Friedel Crafts Reaction: β-Benzoyl propionic acid from succinic anhydride and benzene.
[7] Benzil _ 2,4,5-triphenyl imidizole
[8] Sucrose _ Oxalic acid
[9] Cyclohexanol_ Adipic acid
[10] Benzaldehyde _ Dibenzal acetone
[11] Phenol formaldehyde resin
[12] Urea formaldehyde resin
[13] Methyl acetoacetate _ 5-methyl-isoxazol-3-ol
[14] Ethyl acetoacetate →4-aryl-6-methyl-3,4-dihydro-2(1H)-pyrimidinone ester
[15] Ethyl acetoacetate →Diethyl 1,4-dihydro-2,6-dimethyl-4-phenylpyridine-3,-5dicarboxylate
[16] Dye prepartion : Sulphanilic acid →Methyl orange
[17] Dye prepartion : p-nitroaniline _ p-red
[18] Acetanilide →p-nitroacetanilide →p-nitroaniline
[19] Aniline →2,4,6-tribromo aniline →2,4,6-tribromoacetanilide
[20] Nitrobenzene →m-dinitrobenzene →m-nitroaniline
[21] toluene →p-nitrotoluene →p-nitrobenzoic acid
[22] Glycine →Benzoyl glycine →4-benzilidene-2-phenyl oxazole
[23] Phathalic anhydride →Phthalimide →Anthranilic acid
[24] Resorcinol →fluoroscein →Eosin

PSCChP03: Seminar-I

2 h /week Marks: 25

Seminar of 30 minutes duration will be a part of internal assessment for 25 marks (1 credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

Syllabus prescribed for M.Sc. Chemistry Semester II

PSCChT05: Paper V (Inorganic Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit I: A**) Electronic spectra of Transition Metal complexes 10h**

Determining the Energy terms, Spin-orbit (L-S) coupling scheme, Hund's rule, Hole Formulation, Derivation of the term symbol for a d^2 configuration, Electronic spectra of transition metal complexes – Laporte 'orbital' selection rule,spin selection rule. Orgel diagrams for octahedral metal complexes. Charge transfer spectra, Racah parameters, calculations of 10 Dq, B, β parameters. Tanabe- Sugano Diagrams of octahedral complexes with d^2 & d^8 configuration.

B**) Magnetic Properties of Transition Metal complexes 5h**

Abnormal magnetic properties, orbital contributions and quenching of orbital angular momentum, spinorbit coupling. Magnetic moment, electronic spectra and structure of tetrahalocobalt(II) complexes, tetrahedral and octahedral Ni(II) complexes. High spin-low spins crossover.

Unit – II 15h

Reaction mechanism of Transition Metal Complexres-II

Substitution reaction in square planer complexes: the trans effect, cis effect, steric effect, solvent effect, effect of leaving group, effect of charge, effect of nucleophile, effect of temperature. Trans effect theories, uses of trans-effect, mechanism of substitution reactions in Pt(II) complexes.Electron transfer reactions. Types of electron transfer reactions, conditions of electron transfer, and mechanism of oneelectron transfer reactions, outer sphere and inner sphere mechanisms, two electron transfer reactions complimentary and non-complimentary reactions. Tunneling effect, cross-reaction, Marcus-Hush theory, bridged activated mechanism.

Unit-III: Metal pi-Complexes - I 15h

Metal carbonyls

Structure and bonding, vibrational spectra of metal carbonyls for bonding and structure elucidation, important reaction of metal carbonyls.Metal carbonyl clusters with reference to classification, EAN rule, synthesis and structures.

Unit – IV: Metal pi-Complexes – II 15h

Metal nitrosyls

Nitrosylating agents for synthesis of metal nitrosyls, vibrational spectra and X-ray diffraction studies of transition metal nitrosyls for bonding and structure

elucidation, important reactions of transition metal nitrosyls, structure and bonding. Dinitrogen and dioxygen complexes. Wilkinson's catalyst and Vaska's compound.

List of Books

1. J.E.Huheey :Inorganic Chemistry
2. F.A.Cotton and G. Wilkinson: Advanced Inorganic Chemistry 3rd, 5th and 6th Editions.
3. A.F. Willims: Theoretical Approach in inorganic chemistry.
4. Mannas Chanda: Atomic Structure and chemical Bonding
5. L. E. Orgel: An Introduction To transition metal chemistry, Ligand field theory, 2nd Edition.
6. J. J. Logowski: Modern Inorganic Chemistry
7. B.Durrant and P.J.Durrant: Advanced Inorganic Chemistry
8. J C. Bailar: Chemistry of coordination compounds.
9. W. L. Jolly: Modern Inorganic ChemistryJones: Elementry Coordination chemistry.
10. B. N. Figgis: Introduction to Ligand field.
11. M.C.Day and J.Selbin: Therotical Inorganic Chemistry.
12. J. Lewin and Wilkins: Modern Co-ordination chemistry.
13. Purcell and Kotz: Inorganic Chemistry.
14. D. Banerjea: Co-ordination chemistry, Tata Mc. Graw. Pub.
15. A.F. Wells: Structural inorganic chemistry, 5th Edition, Oxford.
16. S. G. Davies: Organotransition metal chemistry applications to organic synthesis.
17. R. C. Mehrotra: Organometallic chemistry Tata McGraw Hill. Pub.
18. G. S. Manku: Thereotical priciples of inorganic chemistry
19. A. B. P. Lever: Inorganic electronic spectroscopy.
20. R.C.Maurya:Synthesis and charecterisation of novel nitrosyls compounds, Pioneer Pub. Jabalpur 2000.

21. R.H.Crabtree:The Organometalic chemistry of Transition metals, John Wiley.
22. D.N.Styanaryan:Electronic Absorption Spectroscopy and related techniques, University Press.
23. R. S. Drago: Physical methods in inorganic chemistry
24. F.Basolo and G.Pearson: Inorganic Reaction Mechanism
25. Organometallics II and I complexes with transition metal- carbon bonds: Manfred Bochmann-Oxford Press.
26. Advanced Inorganic Chemistry Vol I and II – Satyaprakash, Tuli, Bassu and Madan- S Chand.
27. M.Tsusui,M.Nlevy,M.Ichikwa and K.Mori:Introduction to metal pi-complexe chemistry,Plenum press,NY
28. A.E.Martel;Coordination Chemistry-VolIandII,VNR.

PSCChT06: Paper VI (Organic Chemistry)

60 h (4 h per week): 15 h per unit 80Marks

Unit-I 15 h

A] **Addition to carbon-carbon multiple bond**

Mechanistic and stereochemical aspects of addition reaction involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity, Orientation and stereochemistry, Addition to cyclopropanes, Hydrogenation of double bond and triple bonds. Hydrogenation of aromatic rings, hydroboration, Michael reaction.

B] **Addition to carbon-hetero atom multiple bond**

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters, and nitriles, Addition of Grignard reagents, organozinc and organolithium reagents to carbonyls and unsaturated carbonyl compounds, Wittig reaction, Mechanisms of condensation reactions involvingenolates- Aldol, Knoevengel, Claisen, Mannich, Benzoin, Perkin, Stobbe reaction, Hydrolysis of esters and amide, ammonolysis of esters.

Unit-II 15 h

A] **Mechanism of molecular rearrangement**

Classification and General mechanistic treatment of electrophilic, nucleophilic and free radical moleculer rearrangement. Mechanism of the following rearrangement –Wagner-Meerwin, Pinacol-Pinacolone, Tiffenev –Demjnov ring expansion, benzil-benzilic acid, Arndt-Eistert synthesis, Curtius Lossen, Beckman, Hoffman, Schmidt rearrangement.

B**] Free radical reactions-I**

Type of free radical reactions, free radical substitution mechanism at an aromatic substrate, aliphatic substrate, reactivity at a bridgehead position. Neighbouring group assistance, reactivity for aliphatic and aromatic substrates, reactivity in attacking radicals, effect of solvent on reactivity.

UNIT-III

A**] Free radical reactions-II 15 h**

Halogenation at an alkyl carbon, allylic carbon (NBS), hydroxylation at an aromatic carbon by means of Fenton's reagent. Auto-oxidation, chlorosulphonation (Reed Reaction) Coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction, Free radical rearrangement, Hunsdiecker reaction.

B] **Elimination reactions**

The E1, E2 and E1CB mechanisms and orientation of the double bond. Saytzeff and Hoffman's rule. Effect of substrate structure, attacking base, leaving group and medium. Mechanism and orientation in pyrolytic elimination.

Unit IV: Green chemistry 15 h

Introduction, Education and need of Green chemistry, Basic principles of green chemistry. Prevention or minimization of hazardous products , choice of solvents. Sonochemistry, microvave induced reactions, polymer supported reagents, reactions in aqueous medium, zeolites and ionic liquid supported reaction, Solvent free reactions, Multi-component reactions (Biginelli, Ugi and Passereno reaction), Rearrangements reaction, Addition reaction, substitution, elimination reaction, photochemical and electrochemical reactions, Biocatalysts in Organic synthesis. Synthesis involving basic principles of green chemistry- Synthesis of paracetamol and Ibuprofen, styrene, urethanes, Free radical bromination, Green chemistry for drug development, Synthesis of. Introduction to nanochemistry, nanorods and nanotubes.

List of books

1] Books as Suggested in Semester I for Organic Chemistry
2] A Textbook of organic chemistry- R.K. Bansal
3] New trends in green chemistry –V.K. Ahluwalia and M. Kidwai, Anamaya publishers New Delhi
4] Heterocyclic Chemistry, John Joule, Oxford University Press

PSCChT07: Paper VII (Physical Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

UNIT I: APPLICATION OF QUANTUM MECHANICS 15h

A] Approximate methods, variation principle, MO theory applied to H_2+ molecule and H_2 molecule (calculation of energy), perturbation theory, application of perturbation theory to helium atom .

B] Electronic structure of atoms: Russel Sanders terms and coupling schemes, Slater-condon parameters,term separation energies of the pn configuration, term separation energies for dn configuraconfiguration, magnetic effects: spin orbit coupling and Zeeman splitting.

C] Hybridization, hybrid orbitals in terms of wave functions of s and p orbitals, sp and sp^2 hybridizations, Simple Huckel theory applied to: ethylene, butadiene, cyclobutadiene, cyclopropenyl radical.

UNIT II: THERMODYNAMICS 15h

A] Non-ideal Systems: Excess functions for non ideal solutions, Entropy of mixing, Enthalpy of mixing, Activity, activity coefficients, Debye Huckel theory for activity coefficients of electrolytic solutions, determination of activity and activity coefficients, ionic strength.

B] Statistical thermodynamics: Stirling Approximation, Maxwell Boltzmann, Bose Einestein, Fermi Dirac statistics, comparison between three statistics.

C] Irreversible Thermodynamics: Thermodynamic criteria for non equilibrium states, Le Chatelier principle, Conservation of mass and energy in closed and open systems, entropy production.

UNIT III: SOLID STATE CHEMISTRY 15h

A] Crystal Defects and Non-stiochiometry: Perfect and imperfect crystals, Electronic structure of solids— band theory intrinsic and extrinsic defects- point defects, line and plane defects, vacancies- Schottky defects and Frenkel defects, p-n junction. Thermodynamics of Schottky and Frenkel defects, colour centres, non-stiochiometric defects. Superconductors—Meissner effect, BCS theory.

B] Solid State Reactions: General Principles, experimental procedures, co-precipitation as a precursor to solid state reactions, kinetics of solid state reactions.

UNIT IV: NUCLEAR CHEMISTRY 15h

A] Introduction, radioactive decay and equilibrium, thermonuclear reactions, photonuclear reactions, Radiometric titration, isotopic dilution analysis, NAA.

B] Nuclear models: Fermi gas model, shell model, liquid drop model, application of liquid drop modelsemiempirical mass equation.

C] Counters: proportional counter, GM counter, scintillation counter, ionization chamber counter.

List of books

1. Ira N. Levine, Quantum Chemistry, 5th edition(2000), Pearson educ., Inc.New Delhi
2. A.K.Chandra, Introductory Quantum Chemistry, 4th edition (1994), Tata Mcgraw Hill, New Delhi.
3. S.K.Dogra, S.Dogra, Physical Chemistry Through Problems.
4. M.W.Hanna, " Quantum Mechanics in Chemistry", Benjamin
5. L. Pualing and E. B. Wilson, Introduction to Quantum Mechanics with Applications to Chemistry, McGraw Hill, New York (1935).
6. R.P.Rastogi R.R. Mishra 6th revised edition An Introduction to CHEMICAL THERMODYNAMICS
7. Principles of Physical Chemistry by Puri, Sharma and Pathania,
8. Physical chemistry. P.W.Atkins.ELBS
9. E.N.Yenemin, "Fundamentals of Chemical Thermodynamics", MIR Publishers.
10. F.W.Sears, " Introdction to Thermodynamics, Kinetic Theory of Gases and statistical mechanics".Addison Wesley
11. M.C.Gupta, Statistical Mechanics
12. I.Prigoggine, " An Introduction to Thermodynamics of Irreversible Processes," Interscience
13. Andrew Maczek, Statistical Thermodynamics, Oxford University Press Inc., New York (1998).
14. C.N.Rao. Nuclear Chemistry
15. B. G. Harvey, Introduction to Nuclear Physics and Chemistry, Prentice Hall, Inc. (1969).
16. H.J. Arnikar, Essentials of Nuclear Chemistry, 4th Edition (1995), Wiely-Eastern Ltd., New Delhi.
17. C.Kittel, " Introduction to solid state Physics",Wiley
18. L.V.Azaroff, " Introduction to solids", McGraw Hill

PSCChT08: Paper VIII (Analytical Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Sampling and quantification 15h

Sampling and sample treatment: Criteria for representative sample. Techniques of sampling of gases (ambient air and exhaust gases), liquids (water and milk samples), solids (soil and coal samples) and particulates. Hazards in sampling. Safety aspects in handling hazardous chemicals. Sample dissolution methods for elemental analysis: Dry and wet ashing, acid digestion, fusion processes and dissolution of organic samples.

Detection and quantification: Concepts and difference between sensitivity, limit of detection and limit of quantification, role of noise in determination of detection limit of analytical techniques. Units in chemical analysis and their interconversion. Stoichiometry: Stoichiometric and sub-stoichiometric reactions and calculations.

Unit-II: Modern separation techniques 15h

Gas Chromatography: Principle including concept of theoretical plates and van-Deemter equation. Instrumental set up- carrier gas, sampling system, column and detector. Types of columns, their advantages and limitations. Detectors in GC analysis. Temperature programmed GC. Factors affecting retention, peak resolution and peak broadening.

Liquid chromatography: Principle, Instrumentation, Advantages and applications of HPLC. Types of columns and detectors. Principle and applications of size exclusion, gel permeation, ion retardation, normal phase and reverse phase chromatography.

Supercritical fluid chromatography: Introduction and applications.

Unit-III: Optical methods of analysis-II 15h

Fluorometry and phosphorimetry: Principles of fluorescence and phosphorescence. Jablonski diagram. Concentration dependence of fluorescence intensity. Fluorescence quenching. Instrumentation. Applications.

Flame photometry: Principle. Instrumentation and types of burners. Factors affecting flame photometric determination. Limitations of flame photometry. Interferences in flame photometry. Applications. Nephelometry and turbidimetry: Theory, instrumentation and applications. Optical sensors: Fibre-optic properties, Fibre-optic sensors.

Unit-IV:Electrochemical methods of analysis-I 15h

Polarography: Principle of DC polarography. Instrumentation in polarography. Advantages and limitations of DME. Types of currents- residual current, migration current, diffusion current, limiting current, adsorption current, kinetic current and catalytic current. Ilkovic equation-diffusion current constant and capillary characteristics. Derivation of equation of polarographic wave and half wave potential. Experimental determination of half wave potential. Reversible, quasi reversible and irreversible electrode reactions. Polarographic maxima and maximum suppressor. Oxygen interference and deaeration. Introduction to pulse, a.c. and oscillographic techniques and their advantages. Applications of polarography in determination of dissolved oxygen, metal ion quantification and speciation, simultaneous determination of metal ions, analysis of organic compounds. Limitations of polarography. Amperometric titrations- Principle, types and applications in analytical chemistry.

List of books:

1. Quantitative analysis: Day and Underwood (Prentice-Hall of India)
2. Vogel's Text Book of Quantitative Inorganic Analysis-Bassett, Denney, Jeffery and Mendham (ELBS)
3. Analytical Chemistry: Gary D. Christian (Wiley India).
4. Instrumental Methods of Analysis: Willard, Merrit, Dean, Settle (CBS Publishers, Delhi, 1986)
5. Sample Pre-treatment and Separation: R. Anderson (John Wiley and Sons)
6. Stoichiometry: B.I.Bhatt and S.M. Vora, 2nd Edition (Tata Mc-Graw Hill publication)
7. Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)
8. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
9. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
10. Analytical Chemistry: Problems and Solution- S. M. Khopkar (New Age International Publication)
11. Basic Concepts in Analytical Chemistry: S. M. Khopkar (New Age International Publication)
12. Advance Analytical Chemistry: Meites and Thomas: (Mc Graw Hill)

13. An Introduction to Separation Science: L. R. Shyder and C. H. Harvath (WileyInterscience)
14. Fundamental of Analytical Chemistry: S. A. Skoog and D. W. West
15. Instrumental Methods of Chemical Analysis: G. W. Ewing
16. Polarography: Koltoff and Ligane
17. Electroanalytical Chemistry: Sane and Joshi (Quest Publications)

PSCChP04: Practical-IV (Physical Chemistry)

9 h /week Marks: 80

1. To study the variation of volume contraction with mole fraction of alcohol in alcohol - water system
2. To determine the activation parameters of viscous flow for a given liquid
3. Determination of molecular mass of a polymer by viscometry method.
4. To determine integral heat of KNO3, at two different conc. and calculation of heat of dilution.
5. Effect of 1% NaCl, 1% succinic acid, 0.5% naphthalene on CST in phenol-water systems.
6. Distribution of succinic acid in H2O- benzene, H2O-ether and comparison of distribution coefficient.
7. To construct the phase diagrams of two components system (phenol- urea, diphenyl aminebenzophenone; a-naphtyl amine-phenol) forming compounds with congruent melting points.
8. To study the mutual solubility of glycerol-m-toluidine and to determine congruent points.
9. To study kinetics of hydrolysis of an ester by NaOH reaction.
10. To determine equilibrium constant of the equation $KI+I_2=KI_3$ by distribution method.
11. To study the kinetics of the reaction between potassium persulphate and potassium iodide.
12. Determination of order of reaction of oxidation of ethyl alcohol by acid dichromate.
13. To titrate conductometrically monobasic and dibasic acids with NaOH and determine the strength of given acid.
14. To determine equivalent conductance of weak electrolyte at infinite dilution by kaulrausch's method.
15. Determination of heat of reaction, entropy change and equilibrium constant of the reaction between metallic zinc and Cu^{+2} ions in solution.
16. Determination of thermodynamic constants ΔG, ΔH, ΔS for Zn^{+} $H_2SO_4= ZnSO_4+ 2H$ by emf measurement.

PSCChP05: Practical-V (Analytical Chemistry)

9 h /week Marks: 80

Section (A): Classical methods and separation techniques

Calibration, validation and computers

1. Calibration of pipette and burette.
2. Statistical analysis of data.
3. Use of MS-Excel in statistical analysis of data and curve fitting.

Volummetry

1. Determination of Na_2CO_3 in washing soda.
2. Determination of NaOH and Na_2CO_3 in a mixture.
3. Estimation of nickel in given solution by direct complexometric titration with EDTA using bromopyrogallol red.
4. Estimation of nickel in given solution by complexometric back-titration with EDTA using murexide.
5. Estimation of chloride in given solution by Mohr's titration.
6. Estimation of chloride in given solution by Volhard's titration.
7. Determination of volume strength of commercial hydrogen peroxide by redox titration with $KMnO_4$.
8. Estimation of phenol/ aniline by bromination method.

Gravimetry

1. Estimation of barium as barium sulphate.
2. Estimation of calcium as calcium oxalate/ calcium carbonate/ calcium oxide.

Separation techniques

1. Qualitative separation of metal ions by paper chromatography for 2/3 components.
2. Determination of ion-exchange capacity of resin.

Section (B): Instrumental techniques

Electroanalytical techniques

1. Analysis of commercial vinegar by conductometric titration.
2. Determination of strength of HCl and CH_3COOH in a mixture conductometrically.
3. Determination of strength of HCl and oxalic acid in a mixture conductometrically.
4. Determination of strength of oxalic acid and CH_3COOH in a mixture conductometrically.

5. Determination of degree of dissociation and dissociation constant of acetic acid conductometrically.

6. Determination of strength of HCl and CH_3COOH in a mixture potentiometrically.

7. Determination of Fe(II) by potentiometric titration with $K_2Cr_2O_7$.

8. Determination of three dissociation constants of H_3PO_4 by pH-metric titration.

Optical Optical methods

1. Determination of pK of indicator by colorimetry.

2. To estimate the amount of NH_4Cl colorimetrically using Nesseler's Reagent.

3. To study the complex formation between Fe(III) and salicylic acid and find the formula and stability constant of the complex colorimetrically (Job's method).

4. To determine the dissociation constant of phenolphthalein colorimetrically.

Note: One experiment from each section should be performed in the examination

PSCChP03: Seminar-II

2 h /week Marks: 25

Seminar of 30 minutes duration will be a part of internal assessment for 25 marks (1 credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

GONDWANA UNIVERSITY, GADCHIROLI

M.Sc.-II Semester III, IV (Chemistry)

(Effective from 2017-18) (CBCS)

1. There will be four theory papers in every semester which will carry 80 marks each of 3 hrs. duration.
2. In semester III student will opt for special paper from four options available.
3. In semester IV student will opt for an elective paper out of the five options available.

4. There will be internal assessment of 20 marks per paper per semester.

5. Each paper per semester with total of 100 marks(80+20 i.e. theory+internal assessment) will carry 4 credits.

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

7. There will be two practical examinations in semester III i.e. Pract I(special) and Pract II(Elective) of 6-8 hours duration of 80 marks with 4 credits each.Every practical will be having 20 internal practical marks.
8. In semester IV there will be one practical (Special) and another as Project of 80 marks each.

9. In each semester, the student will have to deliver a seminar on any topic relevant to the syllabus / subject encompassing the recent trends and development in that field / subject. This will carry 25 marks per seminar with one credit.

10. So, the total marks allotted to the Chemistry subject per semester is 625 marks: Theory (320 marks) + Internal assessment (120 marks) + Practicals (160 Marks)+ Seminar (25Marks)= 625marks (total)

11. Each theory paper consists of four units of fifteen hours per unit.

The following syllabi are prescribed on the basis of four hours per week of each paper and nine practical periods per batch per week.

General scheme for distribution of marks in practical examination

Time : 6-8 h (One day Examination) Total Marks : 80)
Exercise-1 - 30 Marks
Exercise-2 - 20 Marks
Viva-Voce -15Marks
Record -15 Marks

Scheme of Examination for M.Sc. (Chemistry) SEM III and IV

Semester III	Internal Assessment	Total Marks	Credits
PSCHT09: Paper IX (Spectroscopy)	20 Marks	80 Marks	4 Credits
PSCHT10: Paper X **Special I**-Inorganic/ Organic Chemistry/Physical/Analytical	20 Marks	80 Marks	4 Credits
PSCHT11: Paper XI **Special II**-Inorganic/ Organic Chemistry/Physical/Analytical	20 Marks	80 Marks	4 Credits
PSCHT12: Paper XII**Elective** Applied Analytical /Nuclear/ Environmental /Polymer/Medicinal Chemistry)	20 Marks	80 Marks	4 Credits
PSCHP07: Practical-VII**Special**Inorganic/ Organic Chemistry/Physical/Analytical	20 Marks	80 Marks	4 Credits
PSCHP08: Practical-VIII**Elective**- Applied Analytical Nuclear/ Environmental /Polymer/Medicinal)	20 Marks	80Marks	4 Credits
PSCHP09: Seminar-III ---- --	25 Marks		1 Credit
Total:	**120 Marks**	**505 Marks**	**25 Credits**

Semester IV

PSCHT13: Paper XIII (Spectroscopy)	20 Marks	80 Marks	4 Credits
PSCHT14: Paper XIV**Special I**-Inorganic/ Organic Chemistry/Physical/Analytical	20 Marks	80 Marks	4 Credits
PSCHT15 Paper XV **Special II**-Inorganic/ Organic Chemistry/Physical/Analytical	20 Marks	80 Marks	4 Credits
PSCHT16 Paper XVI**Elective**- Applied AnalyticalNuclear/ Environmental / Polymer/Medicinal Chemistry)	20 Marks	80 Marks	4 Credits
PSCHP10 Practical-XSpecial (Inorganic / Organic/Physical/Analytical)	20 Marks	80 Marks	4 Credits
PSCHP11 Practical-XI Project	20 Marks	80 Marks	4 Credits
PSCChP12 Seminar-IV ----	25 Marks		1 Credit
Total:	**120 Marks**	**505Marks**	**25 Credits**

Syllabus prescribed for M.Sc. Chemistry Semester III

PSCChT09: Paper IX (Spectroscopy)

60 h (4 h per week): 15 h per unit 80 Marks

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

Symmetry elements and symmetry operations. Properties of group. Point groups and Schoenflies symbols. Symmetry operations as a group. Matrix representations of groups. Multiplication table for C_2v, C_3v and C_2h. Reducible and irreducible representations. Similarity transformation. Classes of symmetry operations. Great Orthogonality Theorem. Derivation of character tables for H_2O and NH_3 using Great Orthogonality Theorem. Application of character tables in selection rules of IR, Raman and Electronic spectroscopy.

Unit - II: 15h

A] Mass spectrometry: Theory, ion production(EI, CI, FD, FAB), ion analysis, ion abundance, isotopic contribution, N-rule, types of fission processes, high resolution mass spectrometry, metastable peak, molecular ion peak, Mclaffferty rearrangement, mass spectral fragmentation of organic compounds alkanes, alkenes, alkynes, alcohols, amines, amides, acids, aldehydes, ketones, halides, Structure determination of organic molecules by mass spectrometry

B] Mossbauer spectroscopy: Basic principle, experimental techniques, recoil emission and absorption, source, absorber, isomer shift, quadrupole interaction, magnetic hyperfine interaction, applications in determining electronic structure, molecular structure, crystal symmetry, magnetic structure, surface studies, biological applications.

Unit - III: 15h

A] Microwave spectroscopy: Classification of molecules on the basis of M.I., rigid and non rigid rotor, effect of isotopic substitution on transition frequencies, stark effect, microwave spectrometer, application in deriving: molecular structure, dipole moment, atomic mass and nuclear quadrupole moment.

B] ESR spectroscopy: Introduction, principle of ESR, ESR spectrometer, hyperfine coupling, zero field splitting, factors affecting g values, Kramer's degeneracy, application of ESR spectra to study free radicals like hydrogen, methyl radical, 1,4 semibenzoquinone, naphthalene, transition metal complexes, biological systems.

Unit IV: 15h

A] Infrared spectroscopy: Diatomic molecules: 1) Molecules as harmonic oscillator, Morse potential energy function, vibrational spectrum, fundamental vibrational frequencies. Force zero pointenergy, isotope effect. The Anharmonic oscillator, the interactions of rotations and vibrations. P,Q,R branches, vibration of polyatomic molecules, selection rules, normal modes of vibration, group frequencies, overtone and combination frequencies. Structure determination of organic molecules by IR spectroscopy.

B] 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. Selection rules, coherent antiStokes Raman spectroscopy, Structure determination from Raman and Infra-red spectroscopy.

List of books

1] Spectroscopic identification of organic compound-RM Silverstein,GC Bassler and TC Morril, John Wally

2] Introduction to NMR spectroscopy-R. J. Abraham, J. Fisher and P Loftus Wiely

3] Application of Spectroscopy to Organic Compound-J. R. Dyer, Printice Hall

4] Organic Spectroscopy-William Kemp, ELBS with McMillan

5] Spectroscopy of Organic Molecule-PS Kalsi, Wiley, Esterna, New Delhi

6] Organic Spectroscopy-RT Morrison and RN Boyd

7] Practical NMR Spectroscopy-ML Martin, JJ Delpench, and DJ Martyin

8] Spectroscopic Methods in Organic Chemistry-DH Willson, I Fleming

9] Fundamentals of Molecular Spectroscopy-CN Banwell

10] Spectroscopy in Organic Chemistry-CNR Rao and JR Ferraro

11] Photoelectron Spectroscopy-Baber and Betteridge

12] Electron Spin Resonance Spectroscopy-J Wertz and JR Bolten

13] NMR –Basic Principle and Application-H Guntur

14] Interpretation of NMR spectra-Roy H Bible

15] Interpretation of IR spectra-NB Coulthop

16] Electron Spin Resonance Theory and Applications-W gordy

17] Mass Spectrometry Organic Chemical Applications, JH Banyon

INORGANIC CHEMISTRY SPECILIZATION
PSCChT10: Paper X **(Special I-Inorganic Chemistry)**

60 h (4 h per week): 15 h per unit 80 Marks

Unit -I 15h

A) Essential and trace metals in biological systems: Biological functions of inorganic elements, biological ligands for metal ions. Coordination by proteins, Tetrapyrrole ligands and other macrocycle. Influence of excess and difficiency of V, Cr, Mn, Fe, Co, Cu,& Zn. Genetic defects in the absorption of trace elements. Regulation and storage of trace elements. Role of minerals. Toxic effects of metals.

B) Metal storage, transport and biomineralization with respect to Ferritin, Transferrin and Siderophores, Na+ /K+ pump. Role of Ca in transport and regulation in living cells.

C) Medicinal use of metal complexes as antibacterial, anticancer, use of cis-platin as antitumor drug, antibiotics & related compounds. Metal used for dignosis and chemotherapy with particular reference to anti cancer drugs.

Unit-II 15h

A) Bio-energetics and ATP cycle: DNA polymerization, metal complexes in transmission of energy, chlorophylls, photosystem I and photosystem II in cleavage of water, Model systems.

B) Electron transfer in Biology: Structure and functions of metalloproteins in electron transfer proteins, cytochromes & Fe-S proteins, Non-heme iron proteins; Rubredoxins, Synthetic models. Biological Nitrogen fixation (in vitro and in vivo)

Unit-III 15h

Transport & Storage of Dioxygen: Heme proteins & oxygen uptake, structure and functions of haemoglobin, myoglobin, hemocyanins & hemerythrin. Perutz mechanism showing structural changes in porphyrin ring system. Oxygenation and deoxygenation. Model compounds. Cyanide poisoning

and treatment. Vanadium storage and transport.

Unit-IV 15h

Metallo enzymes: Apoenzymes, Haloenzyme & Coenzyme. The principle involved and role of various metals ini) Zn-enzyme:- Carboxyl peptidase & Carbonic anhydrase. ii) Fe-enzyme:- Catalase Peroxidase & Cytochrome P-450 iii) Cu-enzyme:-Super Oxide dismutase iv) Molybdenum:-Oxatransferase enzymes, Xanthine oxidase,Co-enzyme Vit.B12, Structure of

vitamin B12 Co-C bond cleavage, Mutase activity of co- Enzyme B-12, Alkylation reactions of Methyl Cobalamin. Synthetc model of enzyme action, stability and ageing of enzyme.

List of Books:

1. Akhmetov, N.: General and Inorganic Chemistry.
2. Aylett, B. and Smith, B.: Problems in Inorganic Chemistry, (English University Press)
3. Bertini, et al: Bioinorganic Chemistry (Viva)
4. Charlot, G and Bezier, D.: Quantitative Inorganic Analysis (johnWiley).
5. Douglas, B. E. McDanirl, D. H. et al: Concept and Models of Inorganic Chemistry (4th edt.) J. Wiley
6. Dutt P. K.: General and Inorganic Chemistry.(Sarat Books House)
7. Fenton, David E.: Biocoordination chemistry, Oxford
8. Jolly, W. L. : Inorganic Chemistry (4th edn.) Addison-Wesley.
9. Katakis, D. and Gordon, G.: Mechanism of Inorganic Reactions.(J.Wiley).

PSCChT11: Paper XI (Special II-Inorganic Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I 15 h

Crystal Structure of Some Simple Compounds:

i) Ionic Crystals &Their structures, radius ratio rule, effect of polarization on crystals.

ii) Covalent structure type- Sphalerite & Wurtzite.

iii) Geometry of simple crystal AB type: NaCl, CsCl & NiAs, reasons for preference for a particular structure in above AB type of compounds.

iv) AB2 type: Fluorite, antifluorites, Rutile structures. Li_2O, Na_2O,$CdCl_2$, CdI_2 structures.

v) Ternary Compounds ABO_3 type: Perovskite, Barium titanate, lead titanate, $CaTiO_3$, Tolerance factor, charge neutrality & deviation structures. $FeTiO_3$.

Unit-II 15h

A) AB_2O_4 type- compounds: Normal & inverse,2-3 and 4-2 spinel ,packing of oxygen in tetrahedral & octahedral sites, sites occupancy number of site surrounding each oxygen, application of charge neutrality principles, site preferences in spinel, distorted spinel.Hausmannite(Jahn-Teller distortions),Factors causing distortion in spinel.

B) Lattice Defects: Per fect &Imperfect crystals, point defects**,** Interstitial, Schottky defect, Frenkel defect, line defect & other entities, thermodynamics of Schottky & Frankel defects. Dissociation, theory of dislocation, plane defects- Lineage boundary, grain boundary, stacking fault, 3D defects, Defects & their concentrations, ionic conductivity in solids, Non stoichiometric compounds. Electronic properties of Non-stoichiometric oxides.

Unit-III 15h

Glasses, Ceramics and composite:

Glasses, Ceramics Composites and Nano-materials: Glassy state, glass formers and Glass Modifiers. Glasses, Ceramics, Clay products, Refractories with reference to: preparation, Properties and applications. Microscopic composites, dispersion, strengtheried and particle reinforced, fibre reinforced Composites, microscopic composites, nanocrystaline phase, preparation procedure, special properties and applications.

Unit-IV 15 h

A) Liquid Crystals: Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematics & smectic mesophases; smectic-Nematic transition clearing temperature-homeotrpic, planer & schlieren textures twisted nematics, chiral nematics, molecular arrngement in smectic A & smectic C phases, optical properties of liquid crystals. Dielectric susceptibility & dielectric constants. Lyotropic phases & their description of ordering in liquid crystals.

PSCChP07: Practical-VII(Inorganic Chemistry Special)

9 h /week Marks: 80

Instrumental methods and Analytical Techniques:

A) Exercise based on experimental technique-

i) Colorimetry and Spectrophotometry: a)Simultaneous determination of manganese ($KMnO_4$) , and Chromium ($K_2Cr_2O_7$) and b) Cobalt and Nickel.

ii) Determination of composition and stability constant of complexes by Job's/continuous variation and mole ratio methods

1. Iron-phenanthroline complex: By Job's method of continuous variation

2. Zirconium-Alizarin Red-S complex: By mole ratio method

3. Copper-Ethylene diamine complex: By slope-ratio method.

iii) PH-metry: stepwise proton-ligand and Metal-ligand stability constant of complexes by Irving Rossotti method.

iv) Polarography: Composition and stability constant of complexes.

v) Flame photometric determination: Na, K and Ca.(Individual or together)

B) Separation and quaqntitative estimation of binary ant ternary mixture by the use of following separation techniques:

i) Paper and thin layer chromatography

ii) Ion exchange

iii) Solvent extraction

iv) Electrophoretic separation

List of Books

1. Day and Underwood: Quantitative Analysis
2. Vogel A.I: A textbook of quantitative Inorganic analysis, Longman.
3. Flaschka: EDTA Titration
4. Meites and Thomas: Advanced Analytical Chemistry.
5. Ewing,G.W.: Instrumental Methods of Chemical Analysis,McGraw-Hill
6. Drago,R.S: Physical Methods in Inorganic Chemistry
7. Christian G.D.: Analytical Chemistry
8. Khopkar S.M.: Basic Concept of Analytical Chemistry.
9. Kolltath and Ligane: Polarography
10. Braun: Instrumental methods of chemical Analysis
11. Willard, Merritt and Dean: Instrumental methods of Chemical Analysis,Van Nostrand
12. Strouts, Crifillan and Wison: Analytical Chemistry.
13. Skoog S.A.and West D.W.: Fundamental of Analytical Chemistry
14. Dilts R.V.: Analytical Chemistry
15. Jahagirdar D.V.- Experiments in Chemistry
16. Chondhekar T.K.- Systematic Experiments in Physical Chemistry,Rajbog S.W.,Anjali Pubn.
17. Wlehov G.J.- Standard methods of Chemical analysis, 6th Ed.
18. Ramesh RandAnbu M,Chemical Methods for Environmenta Analyss:Water and Sedient, Macmillion
India.
19. Akhmetov, N.: General and Inorganic Chemistry.
20. Aylett, B. and Smith, B.: Problems in Inorganic Chemistry, (English University Press)
21. Bertini, et al: Bioinorganic Chemistry (Viva)
22. Charlot, G and Bezier, D.: Quantitative Inorganic Analysis (johnWiley).
23. Douglas, B. E. McDanirl, D. H. et al: Concept and Models of Inorganic Chemistry (4th edt.) J. Wiley
24. Dutt P. K.: General and Inorganic Chemistry.(Sarat Books House)
25. Fenton, David E.: Biocoordination chemistry, Oxford
26. Jolly, W. L. : Inorganic Chemistry (4th edn.) Addison-Wesley.
27. Katakis, D. and Gordon, G.: Mechanism of Inorganic Reactions.(J.Wiley).

ORGANIC CHEMISTRY SPECIALIZATION

PSCChT10: Paper X (Special I-Organic Chemistry)

60h (4h/week) 15h/ unit 80 Marks

UnitI: Photochemistry 15 h

Interaction of radiation with matter, types of excitation, rate of excited molecules, quenching, Quantum efficiency, quantum yield, transfer of excitation energy, actinometry, singlet and triplet states, experimental methods in photochemistry of carbonyl compounds, and transition, Norrish type I and Norrish type II reactions Paterno–Buchi reaction, Photoreduction, Photochemistry of enones, Hydrogen abstraction rearrangement of unsaturated ketones and cyclohexadienones, Photochemistry of parabenzoquinones, photochemistry of Aromatic compounds with reference to isomerisation additon and substitution Photochemical isomerization of cis and trans alkenes, Photochemical cyclization of reaction, Photo-Fries rearrangement, Photo theory reaction of anilides Barton reaction, Hoffmann-Loefler-Freytag reaction, photochemistry of vision, Applications of photochemical methods in synthesis: Isocumene, Cedrene, Hirsutene

Unit II: Pericyclic Reactions 15 h

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1, 3, 5-hexatriene, allyl system, classification of pericyclic reaction. FMO approach, Woodward-Hoffman correlation diagram method and Peturbation of molecular orbital (PMO) approach of pericyclic reaction under thermal and photochemical conditions Electrocyclic reactions, conrotatary and disrotatary motion 4n and (4n+2) systems, with more emphasis on [2+2] and [4+2] Cycloaddition of ketones Secondary effects in [4+2] cycloaddition. Stereochemical effects and effect of substituents on rate of cycloaddition reaction, Diels-Alder reaction, 1,3-dipolarcycloaddition and chelotropic reaction. Sigmotropic rearrangement, suprafacial,and antarafacial shift involving carbon moieties, retension and inversion of configuration, [3,3] and [3,5] sigmotropic rearrangements, Claisen, Cope, Sommelet-Hauser rearrangements, Ene reaction.

Unit III 15 h

A] Oxidation

a) Oxidation of alkanes, aromatic hydrocarbons and alkenes, Dehydrogenation with S, Se, Fremy's salt, DDQ, chloranil and $PhI(OAc)_2$, Oxidation with SeO_2, Epoxidation of olefins, Synthetic application of epoxides, Sharpless asymmetric epoxidation, Dihydroxylation of olefins

using $KMnO_4$, OsO_4, Woodward and Prevost dihydroxylation, Oxidative cleavage of olefins, Ozonolysis

b) Oxidation of alcohols: Chromium reagents, pyridinium chlorochromate (PCC), pyridinium dichromate (PDC), Collin and Jones reagent, Combination of DMSO with DCC, $(COCl)_2$, NCS and $(CH_3CO)_2O$ for oxidation of alcohols, Oxidation with MnO_2, Oppenauer oxidation

c) Oxidation of aldehydes and ketones, Conversion of ketones to α, β-unsaturated ketones and α-hydroxy ketones, Baeyer-Villiger oxidation , Chemistry and synthetic applications of $Pb(OAc)_4$, Dess-Martin periiodinane, IBX

B] Reduction

a) Catalytic heterogeneous and homogeneous hydrogenation, Hydrogenation of alkenes, alkynes and arenes, Selectivity of reduction, Mechanism and stereochemistry of reduction, Raney Ni-catalyst, Adam catalyst, Lindlar catalyst, Wilkinson catalyst.

b) Reduction by dissolving metals, Reduction of carbonyl compounds, conjugated systems, aromatic compounds and alkynes. Birch reduction, Hydrogenolysis

c) Reduction by hydride transfer reagents, Meerwein-Pondorff-Verley reduction, Reduction with $LiAlH_4$ and $NaBH_4$, stereochemical aspects of hydride addition, Derivatives of $LiAlH_4$ and $NaBH_4$, Selectivity issues, Diisobutylaluminium hydride (DIBAL-H), Sodium cyanoborohydride, Reduction with boranes and derivatives Reduction with Bu3SnH., Enzyme catalyzed reduction, Reduction of carbonyl group to methylene, Reduction with diimide and trialkylsilanes

Unit IV: Chemistry of P, S, Si, B, and Ti compounds 15 h

a) Phosphours and sulphur ylide: Preperation and their synthetic application along with stereochemistry b) Umpolung concept: Dipole inversion, generation of acyl anion, use of 1,3-dithiane, ethylmethylthiomethylsulphoxide, bis-phenylthiomethane, metallated enol ethers, alkylidene dithiane, ketone thioacetals, 2-propenethiobismethyl thioallyl anion, thiamine hydrochloride based generation of acyl anion c) Organoboranes- preparation and properties of organoborane reagents e.g. RBH_2, R_2BH, R_3B, 9-BBN, catechol borane. Thexyl borane, cyclohexyl borane, $ICPBH_2$, IPC_2BH, Hydrboration-mechanism, stereo and regeoselectivity, uses in synthesis of primary, secondary tertiary alcohols, aldehydes, ketones, alkenes, Synthesis

of EE, EZ, ZZ dienes and alkyenes. Mechanism of addition of IPC_2BH. Allyl boranes- synthesis, mechanism and uses d) Organo silicon compounds in organic synthesis, Me_3SiCl, Me_3SiH and Paterson synthesis e) Synthetic methodologies based on titanium compounds

List of books

1] Books as suggested in Semester I for organic chemistry

2] Organic Synthesis, The disconnection approach-S. Warren

3] Designing Organic Synthesis-S. Warren

4] Some Modern Methods of Organic Synthesis-W. Carruthers

5] Advance Organic Chemistry Part-B-F. A. Caray and R. J. Sundberg Plenum Press

6] Protective Group in Organic Synthesis-T. W. Greene and PGM

7] The Chemistry of Organo Phosphorous-A. J. Kirbi and S.G. Warren

8] Organo Silicon Compound-C. Eabon

9] Organic Synthesis via Boranes-H. C. Brown

10] Organo Borane Chemistry-T. P. Onak

11] Organic Chemistry of Boron-W. Gerrard

12] Fundamentals of Photochemistry-K. K. Rohatgi-Mukharji, Wiley Eastern Limited

13] Photochemistry-Cundau and Gilbert

14] Aspects of Organic Photochemistry-W. M. Horspoot

15] Photochemistry-J. D. Calvert

16] Photochemistry-R. P. Wayne

PSCChT11: Paper XI Special II- (Organic Chemistry)

60h (4h/week) 15h/ unit 80 Marks

Unit I 15 h

A]Terpenoids 15 h

Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Geraniol, α-terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-carotene, Vitamin A and H

B] Porphyrins: Structure and synthesis of Haemoglobin and Chlorophyll

Unit II 15 h

A] Alkaloids

Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants

Structure, stereochemistry, synthesis and biosynthesis of the following: Ephedrine, (+)-coniine, Nicotine, Atropine, Quinine, Reserpine and Morphine

B] Prostaglandins: Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE2 and PGF2α

Unit-III 15 h

A]Steroids Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progesterone and Aldosterone. Biosynthesis of steroids

B] Plant Pigments

Occurrence, nomenclature and general methods of structure determination, isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Cyanidin-7-arabinoside, Cyanidin, Hirsutidin. Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway

Unit IV: 15 h

A] Carbohydrate: Types of naturally occurring sugars, deoxy sugars, amino sugars, branched chain sugars, methyl ethers and acid derivatives of sugars, general methods of structure and ring size determination with reference to maltose, lactose, sucrose, starch and cellulose.

B] Amino acids, protein and peptides: Amino acids, structural characteristics, acid base property, stereochemistry of amino acids, optical resolution, Stecker synthesis, peptide and proteins structure of peptide and protein, primary, secondary, tertiary and quaternary structure. Reaction of polypeptide, structure determination of polypeptide, Solid phase peptide synthesis, end group analysis.

List of books

1] Chemistry of Alkloids-S. W. Pelletier

2] Chemistry of Steroids-L. F. Fisher and M. Fisher

3] The Molecules of Nature-J. B. Hendricsion

4] Biogenesis of Natural Compound - Benfield

5] Natural Product Chemistry and Biological Significance- J. Mann, R. S Devison, J. B. Hobbs, D. V. Banthripde and J. B. Horborne

6] Introduction to Flavonoids-B. A. Bohm, Harwood

7] Chemistry of Naturally Occurring Quinines-R. H. Thomson

8] The Systematic Identification of Flavonoids- Marby, Markham, and Thomos

9] Text Book of Organic Medicinal Chemistry-Wilson, Geswold

10] Medicinal Chemistry Vol I and II-Burger

11] Synthetic Organic Chemistry -Gurudeep Chatwal.
12] Organic Chemistry of Natural Products Vol I and II-O. P. Agrawal

13] Organic Chemistry of Natural Products -Gurudeep Chatwal

14] A Textbook of Pharmaceutical Chemistry-Jayshree Ghosh

15] Synthetic Dyes Series -Venkatraman

16] Chemistry Process Industries-Shreve and Brink

17] Principal of Modern Heterocyclic Chemistry-L. A. Paquelte

18] Heterocyclic Chemistry-J. Joule and G. Smith

19] Heterocyclic Chemistry-Morton

20] An Introduction to Chemistry of Heterocyclic Compound-J. B. Acheson

21] Introduction to Medicinal Chemistry-A. Gringuadge

22] Wilson and Gisvold Text Book of Organic Medicinal and Pharmaceutical Chemistry-Ed. Robert F Dorge

23] An Introduction to Drug Design-S. S. Pandey and J. R. Demmock

24] Polymer Science-V. Govarikar

25] Principle of Polymer Chemistry-P. J. Flory

26] An Outline of Polymer Chemistry-James Q. Allen

27] Organic Polymer Chemistry-K. J. Saunders

PSCChP07: Practical-VII (Organic Chemistry Special)

9 h /week Marks: 80

[A] Quantitative Analysis

Student is expected to carry out following estimations (minimum 6 estimations.)

1. Estimation of Vitamin “C” Iodometry.

2. Estimation of Phenol by KBrO3-KBr.

3. Estimation of Amine by Bromate/ Bromide solution.

4. Estimation of Formaldyde by Iodometry.

5. Estimation of Glucose by Benedict's solution.

6. Estimation of given carbonyl compound by hydrazone formation.

7. Estimation of Aldehyde by Oxidation method.

8. Determination of percentage of number of hydroxyl group in an organic compound by acetylation method.

[B] Isolation of Organic Compounds from Natural Source (Any six)

a) Isolation of caffeine from tea leaves.

b) Isolation of casein from milk (the students are required to try some typical colour reactions of proteins)

c) Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and Rf value reported.)

d) Isolation of nicotine dipicrate from tobacco

e) Isolation of cinchonine from cinchona bark

f) Isolation of piperine from black pepper

g) Isolation of lycopene from tomatoes

h) Isolation of β-carotene from carrots

i) Isolation of cysteine from hair

j) Isolation of oleic acid from olive oil (involving the preparation of complex with urea and separation of linoleic acid

k) Isolation of eugenol from cloves

l) Isolation of (+) limonine from citrus rinds

[C] QUALITATIVE ANALYSIS

Separation of the components of a mixture of three organic compounds (three solids, two solids and one liquid, two liquids and one solid, all three liquids and identification of any two

components using chemical methods or physical techniques. Minimum 10-12 mixtures to be analyzed

PHYSICAL CHEMISTRY SPECIALIZATION

PSCChT10: Paper X (Special I-Physical Chemistry)

60h (4h/week) 15h/unit 80 Marks

UNIT I 15h

A] Statistical thermodynamics: Concepts of distribution, thermodynamic probability and most probable distribution, ensemble averaging, postulates of ensemble averaging, canonical grand canonical and micro canonical ensembles,corresponding distribution laws using lagranges method of undetermined *multipliers* , ortho and para hydrogen, principle of equipartition of energy, calculation of average energy

B] Partition function, Translational partition function, rotational partition function, vibrational partition function, electronic partition function, applications of partition functions.

UNIT II 15h

A] Electrode Interfaces: Quantum aspects of charge transfer at electrode-solution interfaces, quantization of charge transfer, tunneling. Semiconductor interfaces: Theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces, effect of light at semiconductor solution interface.

B] Electro catalysis: Comparison of electro catalytic activity, importance of oxygen reduction and hydrogen evolution reactions, and their mechanism, volcanoes.

C] Bio-electrochemistry: Threshold membrane phenomena, Nernst Plank equation, Hodges Huxley equations, core conductor models, electrocardiography.

UNIT III 15h

A] CHEMICAL KINETICS**:** Introduction, complex reactions: reversible, consecutive, concurrent, and branching reactions, free radical and chain reactions, steady state treatment, reaction between H2-Br2(thermal and photochemical),H2-Cl2, decomposition of ethane, acetaldehyde, N2O5, Rice Herzfeld mechanism

B] Fast Reactions: relaxation methods, stopped flow methods, flash photolysis, magnetic resonance method, jump method, relaxation time and numericals.

UNIT IV: 15h

A]Photophysical phenomenon: Introduction, prompt fluorescence, delayed fluorescence, and phosphorescence, fluorescence quenching: concentration quenching, quenching by excimer and exciplex emission, fluorescence resonance energy transfer between photoexcited donor and acceptor systems. Stern-Volmer relation, critical energy transfer distances, energy transfer efficiency, examples and analytical significance, bimolecular collisions, quenching and Stern-Volmer equation.

B] Photochemical reactions: photoreduction, photooxidation, photodimerization, photochemical substitution, photoisomerization, photosenitisation, chemiluminescence, photochemistry of environment: Green house effect.

List of books:

1. G.M.Panchenkov and V.P.Labadev, " Chemical Kinetics and catalysis", MIR Publishing
2. E.A. Moelwyn- Hughes, " Chemical Kinetics and Kinetics of Solutions", Academic
3. K.J.Laidler, Chemical Kinetics, Third Edition (1987), Harper and Row, New York
4. J.Raja Ram and J.C.Kuriacose, Kinetics and Mechanism of Chemical Transformations MacMilllan Indian Ltd., New Delhi (1993)
5. 1. J.G. Calvert and J.N. Pitts, Jr., *Photochemistry,* John Wiley and Sons, New York (1966).
6. 2. K. K. Rohtagi-Mukherjee, *Fundamentals of Photochemistry,* New Age International, New Delhi(1986).
7. R. P. Wayne, *Principles and Applications of Photochemistry*, Oxford University Press, Oxford(1988).
8. N. J. Turro, *Modern Molecular Photochemistry,* Univ. Science Books, Sansalito (1991).
9. J. F. L. Lakowicz, *Principles of Fluorescence Spectroscopy,* 2nd Edition (1999), PlenumPublishers, New York.

10. F.W.Sears, " Introdction to Thermodynamics, Kinetic Theory of Gases and statistical mechanics".Addison Wesley
11. M.C.Gupta, Statistical Mechanics
12. Andrew Maczek, *Statistical Thermodynamics,* Oxford University Press Inc., New York (1998).
13. Andrew Maczek, *Statistical Thermodynamics,* Oxford University Press Inc., New York (1998).
14. B.K. Agarwal and M. Eisner, *Statistical Mechanics*, Wiley Eastern, New Delhi (1988).
15. D.A. McQuarrie, *Statistical mechanics*, Harper and Row Publishers, New York (1976).
16. J.O.M.Bokris and A.K.N.Reddy, " Modern Elcrtrochemistry". Wiley
17. S. Glasstone, " Introduction to Electrochemistry" Affilisated East West.
18. D.R.Crow, " The Principle of electrochemistry", Chapman Hall

PSCChT11:Paper XI (Special II-Physical Chemistry)

60h (4h/week) 15h/unit 80 Marks

UNIT-I: 15h

A] Radioactive Decay Processes : Alpha decay- penetration of potential barriers, hindered alpha decay, alpha decay energies. Beta Decay- Fermi theory, energy, Curie plots, comparative half-lives, electron capture, selection rules, forbidden transitions, non-conservation of parity, neutrinos. Gamma decay- life-time of excited states.

B] Nuclear Energy : Basic principles of chain reacting systems, the 4-factor formula, Classification of reactors, Breeder reactor, Reactor associated problems, Reactor safety, Fuel cycle, Re-processing of spent fuel, Nuclear waste management

Unit II: 15h

A] Solid State Reactions: 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. photographic process.

B] Nanoparticles and Nanostructural materials: Introduction,methods of preparation,physical properties,and chemical properties, sol-gel chemistry of metal alkoxide, application of nanoparticles. Nanoporous Materials: Introduction, Zeolites and molecular sieves, determination of surface acidity, porous lamellar solids, composition-structure, preparation and applications.

UNIT-III: Electrochemistry of Solution 15h

A] Metal/Electrolyte interface : OHP and IHP, potential profile across double layer region, potential difference across electrified interface; Structure of the double layer **:** Helmholtz-Perrin, Gouy Chapman model, Stern, Graham Devanathan- Mottwatts, Tobin, Bockris, Devnathan Models

B] Over potentials, exchange current density, derivation of Butler Volmer equation under near equilibrium and non-equilibrium conditions, Tafel plot

C] Electrical double lever, 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.

UNIT IV: Irreversible Thermodynamics 15h

Local equilibria,Thermodynamic criteria for non equilibrium states, generalized flux, forces, phenomenological laws, matter flow and current flow, entropy production and entropy flow for

different irreversible reactions(e.g. heat flow, chemical reaction and electrochemical reactions), saxen relations, reciprocity relations, coupled reactions- Onsager theorem of microscopic reversibility, irreversible thermodynamics of biological systems.

List of books:

1. C.N.Rao. Nuclear Chemistry
2. B. G. Harvey, *Introduction to Nuclear Physics and Chemistry,* Prentice Hall, Inc. (1969).
3. H.J. Arnikar, *Essentials of Nuclear Chemistry*, 4th Edition (1995), Wiely-Eastern Ltd., New Delhi
4. L.V.Azaroff, " Introduction to solids", McGraw Hill
5. C.Kittel, "Introduction to solid state Physics",Wiley
6. J.O.M.Bokris and A.K.N.Reddy, " Modern Elcrtrochemistry". Wiley
7. S. Glasstone, " Introduction to Electrochemistry" Affilisated East West.
8. D.R.Crow, " The Principle of electrochemistry", Chapman Hall
9. I.Prigoggine, " An Introduction to Thermodynamics of Irreversible Processes," Interscience
10. G. Fridlander, J.W. Kennedy, E.S. Macias and J.M. Miller, Nuclear & Radiochemistry, 3rd Edition (1981) John-Wiley & Sons, New York

PSCChP07: Practical-VII **(Physical Chemistry Special)**

9 h /week Marks: 80

Solutions:

1.Study the variation of solubility of potassium hydrogen tartarate with ionic strength using a salt having a common ion and hence determine the mean ionic activity coefficients.

2.Determination of partial molar volume of solute and solvent(ethanol-water,methanol-water,KCl-water mixture)

3.Determination of temp. dependence of the solubility of a compound in two solvents having similar intermolecular interactions(benzoic acid in water and DMSO –water mixture) and calculation of the partial molar heat of solution.

Phase equilibrium:

4. To study the effect of addition of an electrolyte such as NaCl, KCl,Na_2SO_4,K_2SO_4 etc.on the solubility of an organic acid(benzoic acid or salicylic acid).

5. To determine the heat of crystallization of $CuSO_4$,5H2O

6. To determine the heat of reaction involving precipitation of a salt $BaSO_4$

7. To determine transition temperature of $CaCl_2$ by thermometric method and to determine transition temperature of $CaCl_2$, sodium bromide by solubility method

Kinetics:

8. To determine the activation energy of hydrolysis of an ester by acid.

9. Kinetics of reaction between sodium thiosulphate and KI. Determination of rate constant; study of influence of ionic strength

10. Kinetics of decomposition of H_2O_2 catalysed by iodide ion. Also determination of activation energy of reaction.

Electrochemistry:

11. Estimate the concentration of H_2SO_4, CH_3COOH, $CuSO_4.5H_2O$ in a given solution by carrying out conductometric titration against NaOH solution.

12 .Determine the eq. conductance of strong electrolyte(KCl, NaCl, HCl,KNO_3) at several concentration and hence verify Onsager's equation.

13. Carry out the following precipitation titration conductometrically-

a.50 ml.0.02N $AgNO_3$ with 1N HCl

b.50 ml.0.02N $AgNO_3$ with 1N KCl

c. 50 ml 0.004 N $MgSO_4$ with 0.1 N $Ba(OH)_2$

d. 50 ml 0.002 N $BaCl_2$ with 1 N Li_2SO_4

e. 50 ml.0.02 N $BaCl_2$ with 1N K_2SO_4

Potentiometry:

14.Determination of redox potential of the couples($Fe^{2+/}Fe^{3+,}Co^{3+/}Co^{2+,}Cr^{3+/}Cr^{2+,}MnO_4$-/$Mn^{2+(}$any two) and equilibrium constant.

15.Study of complex formation by potentiometry e.g.Ag^{+}-$S_2O_3^{2+,}$-,Fe^{3+-}SCN-,Ag+-NH_3(any two) and calculation of stability constant.

ANALYTICAL CHEMISTRY SPECIALIZATION

PSCChT10: Paper X (Special I-Analytical Chemistry)

60h (4h/week) 15h/unit 80 Marks

Unit-I: Radioanalytical Chemistry-I 15h

Radioactivity-Radiation-Units-Curie, Becquerel, Gray, Rad, Sievert, RBE, REM, Half life, mixed half life, branching decay, different types of radiations and their interactions with matter, radioactive equilibrium, Elementary principles of GM and proportional counters, Gamma Ray Spectrometer,

calibration using standard sources, resolution, numericals.

Unit-II: Optical methods of analysis-III 15h

***Atomic absorption spectroscopy*:** Principle. Atomic energy levels. Grotrian diagrams. Population of energy levels. Instrumentation. Sources: Hollow cathode lamp and electrodeless discharge lamp, factors affecting spectral width. Atomizers: Flame atomizers, graphite rod and graphite furnace. Cold vapour and hydride generation techniques. Factors affecting atomization efficiency, flame profile. Monochromators and detectors. Beam modulation. Detection limit and sensitivity. Interferences and their removal. Comparison of AAS and flame emission spectrometry. Applications of AAS.

Unit-III:Electrochemical methods of analysis-II 15h

***Stripping Voltammetry*:** Principle and technique in anodic and cathodic stripping voltammetry, applications to metal ion analysis, limitations.

Adsorptive stripping voltammetry: Principle, technique, applications to metal ions and organic analysis. Advantages over anodic stripping voltammetry. Catalytic effects in voltammetry.

Working electrodes: Mercury electrodes, carbon electrodes, film electrodes.

***Cyclic voltammetry*:** Principle and technique. Randles-Sevcik equation. Interpretation of voltammogram- reversible, irreversible and quasi-reversible systems. Applications of cyclic voltammetry in study of reaction mechanism and adsorption processes.

Electrochemical sensors *(Chemically modified electrodes):* Biosensors, catalytic sensors and gas sensors. Comparison of voltammetry with AAS and ICP-AES.

Unit-IV: Miscellaneous techniques-I 15h

Photoacoustic spectroscopy: Theory. Instrumentation. Advantages over absorption spectroscopy. Chemical and surface applications of PAS.

***Electrochromatography*:** Principles of electrophoresis. Instrumentation. Zone electrophoresis. Curtain electrophoresis. Applications of electrochromatography. Reverse osmosis. Electrodialysis. Capillary electrophoresis. Applications of capillary electrophoresis. Micellar electrokinetic capillary chromatography.

Electrogravimery: Theory of electrolysis. Electrode reactions. Decomposition potential. Overvoltage. Characteristics of deposits and completion of deposition. Instrumentation. Application in separation of metals.

PSCChT11:Paper XI (Special II-Analytical Chemistry)

60h (4h/week) 15h/unit 80 Marks

Unit-I: Organoanalytical Chemistry 15h

Elemental analysis: Outline of macro, semi-micro, micro and ultra-micro analysis, semi-micro determination of carbon, hydrogen, halogen, sulphur, nitrogen, phosphorous, arsenic, boron and metals in organic compounds.

Functional group analysis: Semi-micro determination of the following functional groups in organic compounds- hydroxyl, amino, nitro, nitroso, azo, N-acetyl, O-acetyl, methyl, aldehydes, ketones, thio, disulphide, sulphonamide, unsaturation and active hydrogen.

KF reagent: Karl Fischer reagent and its use in analysis of water in organic compounds.

Unit-II: Analysis of ores and cement 15h

Ores: Composition and analysis of the followings ores- Bauxite, Pyrolusite, Dolomite, Chromite.

Portland cement: Composition, raw material, manufacturing processes, characteristics, analysis.

Unit III: Water pollution and analysis

Sources of water pollution, composition of potable water, importance of water analysis, sampling and sample preservation, physico-chemical analysis of water. Mineral analysis (temperature, pH, conductivity, turbidity, solids, alkalinity, chloride, fluoride, sulphates, hardness), Demand analysis (DO, BOD, COD, TOC), nutrients (nitrogen-total, nitrate, nitrite, phosphate) and heavy metals (As, Cd, Cr, Hg and Pb). A brief idea of coagulation and flocculation.

Unit-IV: Air pollution and analysis 15h

Air pollution and analysis-classification of air pollutants, sources of air pollution and methods of control, sampling of aerosols and gaseous pollutants and their effects, SO2, NO2, CO, CO2, particulates-SPM, RSPM, High Volume Sampler, Fabric Filters, Cyclones (direct and Reverse), ESP, ozone layer, Green house effect, Heat Islands, Acid Rain.

List of books:

1. Essentials of Nuclear Chemistry: H. J. Arnikar (Willey Eastern Ltd)
2. Substoichiometry in Radioanalytical Chemistry: J. Ruzicka and J Stary (Pergamon Press)
3. Introduction to Radiation Chemistry: J. W. T. Spinks and R. J. Woods
4. Radiochemistry: A. N. Nesmeyanov (Mir Publications)

5. Instrumental Methods of Analysis: Willard, Meriit and Dean(Van Nostrand)

6. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)

7. Vogel's Text Book of Quantitative Inorganic Analysis: Bassett, Denney, Jeffery and Mendham (ELBS)

8. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)

9. Atomic Absorption Spectroscopy: Robinson (Marcol Dekker)

10. Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)

11. Analysis of Water: Rodier

12. Laboratory manual of water analysis: Moghe and Ramteke (NEERI)

13. Electroanalytical chemistry: Joseph Wang

14. Electroanalytical stripping methods: Brainina and Neyman (Wiley-Interscience)

15. Trace analysis: S. Lahiri (Narosa Publishing House)

16. Electroanalytical Chemistry: Bard (Marcel-Dekker)

17. Chemistry in Engineering and Technology- Vol I and II: J.C. Kuriacose and J. Rajaram (Tata-McGraw Hill)

PSCChP07: Practical-VII (Analytical Chemistry Special)
9 h /week Marks: 80

pH-metry

1. Determination of percent Na_2CO_3 in soda ash by pH-metric titration.

2. Determination of isoelectric point of amino acid.

Conductometry

1. Displacement titration of CH_3COONa with HCl.

2. Precipitation titration of $MgSO_4$ and $BaCl_2$.

Potentiometry

1. Estimation of Cl-, Br- and I- in a mixture.

2. Determination of percent purity of phenol by potentiometric titration with NaOH.

Coulometry

1. Estimation of nickel and cobalt by coulometric analysis at controlled potential.

2. Analysis of antimony (III) with I3- .

Polarography

1. Determination of E1/2 of Cd^{2+} and Zn^{2+} at DME.

2. Estimation of Cd^{2+} and Zn^{2+} in respective solutions by calibration curve and standard addition methods.

3. Determination of composition /stability constant of complex.

Cyclic voltammetry

Study of cyclic voltammograms of $K_3[Fe(CN)_6]$.

Electrogravimetry

Estimation of nickel and copper individually as well as in mixture.

Polarimetry

1. Inversion of cane sugar in the presence of HCl.

2. Determination of percentage of two optically active substances (d-glucose and d-tartaric acid) in a mixture.

Colorimetry/spectrophotometry

1. Simultaneous determination of chromium and manganese in given mixture.

2. Simultaneous determination of two dyes in a mixture.

3. Estimation of Mn in steel.

4. Estimation of Cu/Ni in alloys.

5. Estimation of iron in water sample using 1,10-phenanthroline.

6. Estimation of Fe(III) in given solution by photometric titration with EDTA (salicylic acid method).

Flame photometry

Estimation of Li, Na, K, Ca in rock/ soil / water samples.

Turbidimetry and nephelometry

1. To determine molecular weight of polymer.

2. Estimation of sulphate in water sample by turbidimetry.

3. Estimation of phosphate by nephelometry.

Radioanalytical techniques

1. *GM-counter*: Plateau, nuclear statistics, half thickness of aluminium absorbers, dead time.

2. *Gamma ray spectrometer*: Calibration using standard sources, determination of half life (Mn-56, I-128, In-116)

3. Experiments based on radiation chemistry: G-value, radiolysis of organic solvents.

Demonstrations

UV-spectrophotometry

PSCChT12: Paper XII (Elective- Applied Analytical Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Analysis of Pesticides and Fertilizers 15h

***Pesticides*:** General introduction, analysis of pesticides in general with reference to DDT, Dieldrin, Malathion, Parathion, BHC by different analytical methods such as titrimetric, colorimetric, chromatography and electroanalytical methods.

***Fertilizers*:** Sampling and sample preparation, determination of water, total nitrogen, urea, total phosphates, potassium, acid or base forming quality.

Unit-II: Forensic chemistry 15h

Introduction. Classification of poisons on the basis of physical states, mode of action and chemical properties with examples of each type. Methods of administration. Action of poisons in body. Factors affecting poisoning. Study of some common poisons used for suicide. Signs and symptoms of As, Pb, Hg and cyanide poisoning. Poisonous effects of kerosene and cooking gas.

Unit-III:Analysis of petroleum and petroleum products 15h

Introduction, determination of flash and fire point, Pensky Marten's apparatus, cloud and pour point, aniline point, drop point, viscosity and viscosity index, Redwood and Saybolt viscometer, API specific gravity, water and sulphur in petroleum products, carbon residue, corrosion stability, decomposition stability, emulsification, neutralization and saponification number.

Unit-IV: Analysis of alloys 15h

Definition of alloy. Iron-carbon phase diagram. Types of steel: hypoeutectic, hypereutectic steels, mild steel, and stainless steel. Uses of steel. Composition and uses of brass, bronze and soldering alloy. Analysis of iron, nickel, chromium and manganese in steel. Analysis of copper in brass, zinc in bronze and lead in soldering alloy. Industrial applications of alloys.

PSCChP08: Practical VIII–Elective (Applied Analytical Chemistry)

9 h per week (Marks-80)

1. Analysis of ores: Ca and Mg in Dolomite, Al in Bauxite, Mn in Pyrolusite.

2. Analysis of cement: Silica, alumina, ferric oxide, calcium and magnesium oxide, sodium and potassium oxide.

3. Alloy analysis: Mn in steel-colorimetry, Cu in brass-colorimetry, Ni in alloy- back titration/

extraction- spectrophotometry.

4. Analysis of oils: Carbon residue, Acid value, Saponification value, Iodine value, Viscosity, Flash point, Cloud point, Aniline point.

5. Analysis of soils: pH, alkalinity, conductivity, nitrogen, phosphorous and potassium.

6. Ambient air analysis: SPM, RSPM, SOx and NOx in ambient air.

7. Analysis of drugs: Fe in capsule, ascorbic acid in vitamin-C tablet, sulpha drug by diazotization, Mg in milk of magnesia tablet.

8. Bleaching powder: Available chlorine, break point chlorination.

9. Polymer analysis: Molecular weight, Saponification value, Iodine value.

10. Cosmetics analysis: Talcum powder, tooth paste, shampoo.

11. Food: Moisture content by Karl-Fischer titrator, phosphoric acid in cola beverages by pH titration.

List of books

1. ISI Handbook of Food Analysis: Vol.I to X (Bureau of India Standards Publication, New Delhi)

2. Food Analysis: A. G. Woodman (McGraw-Hill)

3. Milk and Milk Products: Eckless, Comb and Nacy (Tata McGraw-Hill)

4. Hand Book of Analysis and Quality Control for Fruit and Vegetable Products: Ranganna (Tata McGraw-Hill)

5. Insecticides- Action and Metabolism: O. Brian (Academic Press)

6. Chemistry of Insecticides and Fungicides: Sree Ramalu, Oxford, IBH,Pub.

7. Analytical Methods for pesticides and plant growth regulators and food additives-(Vol.I to X)Ed. G. Zweing (Academic press)

8. Practical Pharmacognosy: T. N. Vassudevan

9. Aids of analysis of food and drugs: Wicholls

10. Indian Pharmacopoeia-1985

11. British Pharmacopoeia-1990

12. Handbook of Drugs and cosmetics aids: Mehrotra

13. Lynch's medical laboratory technology: S. S. Raphel

14. Basic Food Chemistry: F. Lee (AVI publishing company)

15. Industrial chemistry: B. K. Sharma

16. Parikh's text book of medical jurisprudence, forensic medicine and toxicology, 6th Edn.: C.K.Parikh (CBS publishers and distributors)

17. Clarke's analysis of drugs and poisons: Anthony C Moffat, M David Osselton, Brian Widdop (Pharmaceutical press)

18. A Practical Course in polymer chemistry: S. J. Punea (Pergamon press).

19. The Text book on Petrochemical by Dr. B. K. Bhaskar Rao (Khanna Publishers).

20. Analytical chemistry: A. Gupta (Pragati Prakashan)

21. Applied Chemistry: Vermani and Narula (New Age International)

PSCChT12: Paper XII (Elective- Nuclear Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Radioactive decay 15h

Various modes of decay, natural radioactivity, successive radioactive decay and growth kinetics, radioactive equilibrium, half life, half life of mixed radioisotopes, decay schemes, its determination by experimental methods, statistical nature of nuclear radiation, treatment of nuclear data and calculation of standard deviation, probability

Unit-II: Nuclear structure 15h

mass-energy relationship, nuclear binding energy, semi-empirical mass formula, nuclear stability rules, nuclear properties, mass size, spin and parity, nature of nuclear forces, liquid drop model, shell model, its evidence and advantages, comparison of the two models, calculations based on above.

Energetics of nuclear reaction, cross reaction, comparison with chemical reactions, various types of nuclear reactions, photonuclear, spallation and thermonuclear reaction

Unit-III: Interaction of radiations with matter, detectors 15h

Interaction with matter and detection of gamma rays with matter by photoelectric, Compton and pai production, interaction of beta particles, neutrons and heavy charged particles, various methods of detecting nuclear radiations, gas filled counters, ionization chamber, proportional and GM counters, scintillation detector and solid state detector

Unit-IV: Nuclear fission and Fusion 15h

Probability, mass and charge distribution, release of energy and neutrons, spontaneous fission, nuclear reactors and their uses for power production, brief idea about thermal and fast breeder reactors, reprocessing of nuclear fuel, PUREX process, heavy water- manufacturing and use in reactors. accelerators, nuclear fusion.

Production of isotopes by nuclear reactions, production of new elements, radioactive waste management and disposal

PSCChP08: Practical VIII–Elective (Nuclear Chemistry)

9 h per week (Marks-80)

1. Working of GM counter, plateau, statistics, geometry effects, dead time, energy of beta particle, back scattering

2. Working of gas flow proportional counter, plateau, statistics, geometry effects, dead time, energy of beta particle

3. Working with scintillation counter, gamma ray spectra, energy calibration and resolution, half life determination of single and composite nuclei.

4. Radiochemical separation of 234Th from natural uranium salt and its half life determination

5. Experiment on Neutron Activation Analysis by non-destructive method

6. Dose measurement by Fricke and other chemical dosimeters

7. Radiolysis of potassium nitrate, methyl iodide, carbon tetrachloride-iodine systems

8. Szilard-Chalmers reactions with inorganic and organic systems, potassium permanganate and methyl iodide

9. Some trace experiments like partition coefficient, solubility product, isotopic exchange, isotope dilution analysis, radiochromatography, ion exchange.

List of books:

1. H. J. Arnikar - Essentials of Nuclear Chemistry (Willey Eastern Ltd)

2. G. Friendlander, J. W. Kennedy,E. S. Macias and J. M. Miller-Nuclear and Radiochemistry (Wiley Intersciences, New York)

3. G. R. Choppin and J. Rydberg- Nuclear Chemistry-Principles and Applications(Pergamon press, London)

4. B. G. Harvey-Introduction to Nuclear Physics and Chemistry(Prentice Hall of India)

A. N. Nesmeyanov - Radiochemistry- (Mir Publications)

5. M. N. Sastry-Introduction to Nuclear Science, Affiliated East-West Press, New Delhi

6. G. Hughes- Radiation Chemistry- Oxford University Press, London

I. V. Verschinskii and A. K. Pikeav-Introduction to Radiation Chemistry, Israel Publication, Jerusalem- Robinson (Marcol Dekker)

7. Farhat Aziz and M. A. J. Radgers-Radiation Chemistry-Principles and Applications, VCH Publishers FRC.

8. M. Hassinsky-Nuclear Chemistry and its application, Addison Wesley

PSCChT12: Paper XII (Elective- Environmental Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit -I: Concept and scope of Environmental Chemistry 15 h

Biosphere, Lithosphere, Hydrosphere and Atmosphere, Ecological principles- aspects of ecology, classification, types of ecosystems. Biogeochemical cycles- carbon, nitrogen, phosphorous, oxygen, hydrogen, sulphur, iron, sodium, potassium, magnesium, cobalt, mercury, lead, zinc and cadmium.

Thermal pollution—sources, harmful effects and prevention of thermal pollution.

Noise pollution --- sources, effects and control of noise pollution.

Unit-II: Water 15 h

Origin, physico-chemical properties of water, sources of water, hydrological cycle, criteria of water quality, Water management- water shed management, rain water harvesting, waterpollution- sources, consequences and harmful effects of water pollution, strategies for water pollution control.

Unit-III: Air 15 h

Major regions of the atmosphere, composition of the atmosphere, temperature inversion and air pollution episodes, photochemistry of the atmosphere, depletion of the stratospheric ozone, green house effect, green house gases, remedial measures for reversion of green house effect, acid rain, photochemical smog, particulate matter.

Unit-IV: 15 h

Soil

Chemical and mineralogical composition of soil, classification of soil, types of soil- saline and alkaline, physical properties – texture, bulk density, permeability, chemical properties—Ion exchange capacity, soil pH and micro and macro nutrient availability. Soil management—Management of saline and alkaline soil, soil indicator plants,

Radioactive Pollution

Introduction to radiation chemistry, sources of radioactive pollution, effects of radioactivepollution, nuclear disasters in the two decades, protection from radiation, control of radiation.

PSCChP08: Practical VIII–Elective (Environmental Chemistry)

9 h per week (Marks-80)

1. Sampling of water- tap water, well water, over head storage tank water pond water and lake water.

2. Physico-chemical and organoleptic characteristics of the above water samples.

3. Statistical evaluation of the data obtained for optimization of results.

4. Determination of Total solids, Total dissolved solids and total suspended solids and its significance.

5. Determination and comparison of chlorine content in tap water, storage tank and swimming pool.

6. Determination of acidity and alkalinity in water samples.

7. Determination of total, permanent and temporary hardness of water sample.

8. Determination of DO, COD and BOD of water sample.

9. Analysis of chemicals used in water and waste water treatment-Alum, bleaching powder, activated carbon.

10. Analysis of nutrients – Nitrogen (total, ammonia,nitrite and nitrate), Phosphate total

11. Analysis of iron and manganese in a water sample by visual titrimetry.

12. Analysis of copper and nickel in a water sample by spectrophotometry

13. Analysis of different types of soil- pH, conductivity, alkalinity

14. Determination of N,P,K of soil

15. Determination of macro and micro nutrients in soil.

List of books

1. Water analysis : J. Rodier

2. A Text book of Inorganic Analysis : A.I.Vogel

3. Colorimetric Determination of metals : E.B.Sandell

4. Environmental Chemistry : Moore J W and Moore E A. Academic Press, New York, 1976.

5. Environment and Man Vol VII: The Chemical Environment Edited by J Lenihar and W Fleecher Vlackie Publication, 1977.

6. The Chemistry of Environment: R A Horne, Wiley Interscience Publication 1978.

7. Fundamentals of Air Pollution: A C Stern

8. Instrumental Methods of Analysis: Willard,Merrit and Dean

9. Analytical Chemistry: Meites and Thomas

10. Standard Methods for Examination of water and waste water: A E Greenberg, A D Eaton, APHA,

AWWA,WEF

11. Chemistry for Environmental Engineering and Science: C N Sawyer, P L McCarty and G F Parkin

12. Laboratory Manual for the Examination of Water, waste water and soil: H H Rupa and H Krist, V C H Pub.

13. Manual on Water and Waste water analysis: D S Ramteke and C A Moghe, NEERI

14. Environmental Chemistry: B K Sharma and H Kaur

15. Environmental Chemistry: A K De

16. Environmental Pollution- Management and control for sustainable Development: R K Khatoliya

17. Environmental Chemistry: A K Bhagi and G R Chatwal

PSCChT12: Paper XII (Elective- Polymer Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I:Introduction to polymers 15h

Nomenclature and classification of polymers. Types of polymers- linear, branched, crosslinked, ladder, thermoplastic, thermosetting, fibres, elastomers, natural polymers, addition and condensation polymers.

Stereoregular polymers- atactic, syndiotactic and isotactic.

Unit-II:Molar mass and its determination 15h

Molecular mass and molar distribution. Number average, mass average, viscosity, average molecular mass and relation between them. Molecular mass distribution. Determination of molecular mass- Osmometry (membrane and vapour phase), light scattering, gel permeation chromatography, sedimentation and ultracentrifuge, viscosity method and end-group analysis.

Unit III: Physical characteristics of polyemers 15h

Morphology and order in crystalline polymers. Configuration of polymer chains, crystal structure of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. The glass transition temperature (Tg), relationship between Tg and TT, Effect of molecular weight,

dilments, chemical structure, chain topology, branching and cross linking. Methods of determination of glass transition and crystallinity of polymers.

Unit IV: Commercial polymers 15h

A) Organic polymers: Commercial polymers, synthesis and and application of polyethylene,

polyvinyl chlorides, polyaimdes, polyesters, phenolic resins and eposy resins.

B) Functional polymers: Fire retarding polymers and conducting polymers.

PSCChP08: Practical VIII–Elective (Polymer Chemistry)

9 h per week (Marks-80)

1. Synthesis of polymers:

a) Synthesis of Thiokol rubber (condensation)

b) Urea-formaldehyde (condensation)

c) Glyptal resin: glycerine phthalic acid (crosslinked Polymer Chemistry)

d) Polyacryonitril (bulk polymerization)

e) Polyacryonitril (emulsion polymerization)

f) Polymethylomethacrylate (emulsion of suspension Polymer Chemistry)

g) Nylon-66 (interfacial polycondensation)

h) Coordination polymers

i) Conducting polymer (electro- or peroxodisulphate oxidation)

2. Characterization of polymers:

a) End-group analysis

b) Viscosity and molecular mass

c) Density of polymer by flotation methods

d) IR spectra.

3. Purification and fractionation of polymer, polystyrene, Nylon 66, PMMA.

4. Magnetic and electrical properties of polymers, magnetic susceptibility and electrical conductivity of coordination and conducting polymers.

5. Thermal analysis and degradation of polymers

TGA: Isothermal and non-isothermal

DTA: Glass transition temperature and melting point

6. Crystallinity of polymers by density measurement.

7. Swelling and solubility parameters of polymers.

8. Synthesis of Graft-Polymers and its characterization by density and IR spectra.

9. Dielectric behavior of polymers.

10. Kinetics of polymerization:

a) Polycondensation

b) Peroxide initiation polymerization.

List of books:

1. Textbook of polymer science: F.W. Billmayer Jr. Wiley.

2. Polymer science: V.R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern.

3. Fractional monomers and polymers: K Takemoto, Y. Inaki, and R.M. Ottam Brite.

4. Contemporaty polymer chemistry: H.R. Alcock and F. W. Lambe, Prentice Hall.

5. Principles of polymer Chemistry: Flory, Cornell Univ. press.

6. Introduction to polymer chemistry: R. B. Seymour, McGraw Hill.

7. Principles of polymerization: Odian.

8. A first course in polymer chemistry: A. Strepikheyew, V. Derevistkay and G. Slonimasky, Mir Publishers, Moscow.

9. Laboratory preparation of macro chemistry: EMM effery, McGraw Hill Co.

10. A practical course in polymer chemistry: S.J. Punea , Pergamon Press.

PSCChT12: Paper XII (Elective- Medicinal Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

UNIT-I: 15 h

A] Biological response to drug, significance of drug metabolism in medicinal chemistry ,Prodrugs, computer aided drugs, molecular modelling and drug design, Clinical studies, medical formulations ,Stereochemistry and drug development

B]Cardiovascular Drugs: Introduction, cardiovascular diseases, Synthesis of nitrate,verapami, methyldopa, atenolol.

UNIT-II: 15 h

A] Antineoplastic Agent: Introduction, classification,cancer chemotherapy, cancer causing chemicals, role of alkylating agents and antimetabolites in treatment of cancer, hormone and natural products. Synthesis of melphalan , thiotepa, lomustine

B] Antidiabetic Agents- Type-I and Type-II diabetes, Insulin, thiazolidinediones, Synthesis of ciglitazone.

UNIT-III: 15h

A] Local Anti-infective drug: Introduction and general mode of action. Synthesis of sulphonamides, ciprofloxacin, norfloxacin, dapsone ,amino salicylic acid, isoniazid, ethionamide, ethambutal, econozole, griseofulvin.

B] Diuretics: Introduction, mode of action, loop diuretics. Synthesis of Bumetanide, Frusemide, Ethacrynic acid, clorexolone Quinethazone.

C] Analgesics and Antipyretics: Introduction, mode of action, evaluation of analgetic agents.

Synthesis of: Aspirin, salsalate, phenacetin, phenylbutazone, Indomethacin, Analgin.

UNIT-IV: 15 h

A] Psychoactive drugs: Introduction, CNS depressants, Introduction and mode of action of Barbiturates, Benzodiazepenes, hydantoins, butyrophenones, buspirone, CNS Stimulants, Synthesis of Phenobarbital, thiopental sodium ,diazepam, lorazepam, bromazepam, ethosuximide **B]Coagulant and Anticoagulants:** Introduction, factors affecting coagulant and anti-coagulant. Mechanism of Blood coagulation and Anticoagulation. Structure of Vitamin K1, Vitamin K2 and heparin. Synthesis of Coumarins and indanediones.

PSCChP08: Practical VIII–Elective (Medicinal Chemistry)

9 h per week Marks-80)

1. Volumetric estimation of Ibuprofen.

2. Estimation of aspirin by volumetric and instrumental methods.

3. Analysis of ascorbic acid in biological/tablet sample.

4. Determination of paracetamol by colorimetry.

5. Analysis of ampicillin trihydrate.

6. Determination of vitamin B12 in commercial sample by spectrophotometry.

7. Determination of phenobarbitone in given cough syrup.

8. Determination of tetracycline in given capsule.

9. Determination of iron, calcium and phosphorus from milk or drug sample.

10. Determination of glucose by glucometer.

11. To perform I.P. monograph of tablet.

12. Estimation of uric acid in serum and urine.

13. Estimation of chloride in serum and Urine.

14. Estimation of liver glycogen.

15. Determination of blood cholesterol.

16. Determination of creatinine and creatine in blood/Urine.

17. Separation and determination of sulpha drugs in tablets or ointments.

Preparation of Drugs: Synthesis, purification and identification of (8-10) of the following drugs.

1. Benzocaine from p-nitrobenzoic acid.

2. Dapsone from diphenyl sulphone.

3. Paracetamol from p-nitro phenol.

4. Uracil from sulphanil amide.

5. Diphenyl hydantion from benzoin.

6. Aluminium asprin from salicylic acid.

7. 4,6-diphenyl-thiazine from chalcone.

8. 6/8 nitro coumarin from resorcinol.

9. Copper aspirin from salicylic acid.

10. N-acetyl parabanic acid.

11. Nerolin from 2-naphthol

12. Phenothiazine from diphenylamine

13. Umbelliferon from resorcinol

14. Benzylidene from benzaldehyde and aniline

15. 1-phenyl-1,2-pentadine-3-one from benzaldehyde

16. 1,5 diphenyl-1,3-pentadiene-2-one from benzaldehyde

17. 1,3-diphenyl-prop-2-ene-1-one

18. 3-methy pyrazol-5-one from ethylacetoacetate

19. 6-methyl uracil

20. Sulphanilamide from acetanilide

List of books:

1. Text book of organic medicinal chemistry-Wilson,Geswold

2. Medicinal chemistry Vil I and II-Burger

3. A textbook of pharmaceitical chemistry-Jayshree Ghosh

4. Introduction to medicinal chemistry-A Gringuadge

5. Wilson andGisvold text book of organic medicinal and pharmaceutical chemistry-Ed.Robert F Dorge

6. An introduction to drug design-SS Pandey,and JR Demmock

7. Goodman and Gilmans pharmacological basis of therapeutics- Stragies for organic drug sythesis and design-D Lednicer

8. Textbook of Medicinal Chemistry- A. Kar

9. Medicinal Chemistry – D Sriram and P.Yogeeswari

PSCChP09: Seminar-III

2 h /week Marks: 25

Seminar of 30 minutes duration will be a part of internal assessment for 20 marks (1 credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

Syllabus prescribed for M.Sc. Chemistry Semester IV

PSCChT13: Paper XIII (Spectroscopy)

60 h (4 h per week): 15 h per unit 80 Marks

Unit I: 15 h

A] Ultraviolet and visible spectroscopy: Natural line width, line broadening, transition probability, Born-Oppenheimer approximation, rotational, vibrational and electronic energy levels. General nature of bandspectra. Beer- Lambert Law, limitations, Frank-Condon principle, various electronic transitions, effect ofsolvent and conjugation on electronic transitions, Fiesher Wooodward rules for dienes, aldehydes andketones. Structure differentiation of organic molecules by UV Spectroscopy

B] Photoelectron spectroscopy: Basic principles, photoelectric effect, ionization process, Koopman theorem,PES and XPES, PES of simple molecules, ESCA, chemical information from ESCA, Auger electron spectroscopy.

Unit II: Nuclear magnetic Resonance Spectroscopy 15 h

Magnetic properties of nuclei, resonance condition, NMR instrumentation, chemical shift, spin spininteraction, shielding mechanism, factors affecting chemical shift, PMR spectra for different types of organicmolecules, effect of deuteration, complex spin spin interaction (1st order spectra), stereochemistry, variationsof coupling constant with dihedral angle, electronegativity, Karplus equation etc., classification of molecules

as AX, AX_2, AMX, A_2B_2, Shift reagents. NMR studies of 13C, chemical shift in aliphatic, olefinic, alkyne,aromatic, heteroatomic and carbonyl compounds, 19F, 31P. Structure determination of organic molecules byNMR spectroscopy,

Unit III: 15 h

A] Application of NMR spectroscopy: FT-NMR, advantages of FT-NMR, use of NMR in medical diagnosis, 2dimensional NMR spectroscopy-COSY, NOSEY, DEPT, INEPT, APT, INADEQUATE techniques, Nuclearoverhauser effect, nuclear quadrupole resonance spectroscopy: quadrupole nuclei, quadrupole moment,electric field gradient, coupling constant, splitting, applications.

B] Problems based on structure determination of organic molecules by using combined spectral techniques.

Unit IV: Diffraction techniques 15 h

X ray diffraction: Braggs condition, Miller indices, Laue method, Bragg method, Debye Scherrer method,identification of unit cells from systematic absences in diffraction pattern,, structure of simple lattices and xray intensity, structure factor and its relation to intensity and electron density, absolute configuration ofmolecules, Ramchandran diagram.

Electron diffraction: scattering intensity vs scattering angle, Wierl equation, measurement techniques,elucidation of structure of simple gas phase molecules, low energy electron diffraction and structure ofsurfaces.

Neutron diffraction: Scattering of neutrons by solids and liquids, magnetic scattering, measurementtechniques, elucidation of structure of magnetically ordered unit cell.

List of books

1] Spectroscopic identification of organic compound-RM Silverstein,GC Bassler and TC Morril, John Wally
2] Introduction to NMR spectroscopy-R. J. Abraham, J. Fisher and P Loftus Wiely
3] Application of Spectroscopy to Organic Compound-J. R. Dyer, Printice Hall
4] Organic Spectroscopy-William Kemp, ELBS with McMillan
5] Spectroscopy of Organic Molecule-PS Kalsi, Wiley, Esterna, New Delhi
6] Organic Spectroscopy-RT Morrison and RN Boyd
7] Practical NMR Spectroscopy-ML Martin, JJ Delpench, and DJ Martyin
8] Spectroscopic Methods in Organic Chemistry-DH Willson, I Fleming
9] Fundamentals of Molecular Spectroscopy-CN Banwell
10] Spectroscopy in Organic Chemistry-CNR Rao and JR Ferraro
11] Photoelectron Spectroscopy-Baber and Betteridge
12] Electron Spin Resonance Spectroscopy-J Wertz and JR Bolten
13] NMR –Basic Principle and Application-H Guntur
14] Interpretation of NMR spectra-Roy H Bible
15] Interpretation of IR spectra-NB Coulthop
16] Electron Spin Resonance Theory and Applications-W gordy
17] Mass Spectrometry Organic Chemical Applications, JH Banyon
18] Spectroscopy- H. Kaur

INORGANIC CHEMISTRY SPECIALIZATION

PSCChT14: Paper XIV(Special I-Inorganic Chemistry)

60h (4h/week) 15h/ unit 80 Marks

Unit-I 15h

A) Nanoparticles& Nanostructural materials: Introduction, methods of preparation, physical properties, andchemical properties. Molecular Precursor routes to inorganic solids:- Introduction, sol-gel chemistry of metalalkoxide, hybrid organic-inorganic compounds. Nanoporous Materials: Introduction, Zeolites & molecularsieves, determination of surface acidity, porous lamellar solids, composition-structure, preparation &applications.

B) Solid State Reaction: General principles, reaction rates, reaction mechanism, reaction of solids, factorsinfluencing reactivity, photographic process.

Unit-II 15h

A) Coordination Polymers:

Coordination polymers and their classification. Synthesis and applications of coordination polymers. Use ofpolymeric ligands in synthesis of coordination polymers. Organosilicon polymers. Synthesis and their uses.

B) Characterization of coordination polymers on the basis of:

i) Spectra (UV, Visible, IR and NMR)

ii) Magnetic and thermal (TGA,DTA and DSC) studies

Unit-III 15h

Catalysis: Basic principles, thermodynamic and kinetic aspects, industrial requirements, classification,theories of catalysis, homogeneous and heterogeneous catalysis. Introduction, types & characteristics ofsubstrate-catalyst interactions, kinetics and energetic aspects of catalysis, selectivity, stereochemistry, orbitalsymmetry and reactivity. Catalytic reactions of coordination and Organometallic compounds includingpolymerization activation of small molecules, addition to multiple bonds, hydrogenation Zeigler-Nattapolymerization of olefins, hydroformylations, oxidations, carbonylations and epoxidation

.**Unit-IV 15h**

A) Supramolecular chemistry:Molecular recognition: Molecular receptors for different types of moleculesincluding arlsonic substrate, design nad synthesis of co receptor molecules and

multiple recognition.Supramolecular reactivity and catalysis.Transport processes and carrier design. Some examples of selfassemblyin supramolecular chemistry.

B) Thin films and languir-Biodgett films: Preparation technique, evaporation/spultering, chemical processes,MOCVD, solgel etc. Languir-Biodgett(LB) film, growth techniques, photolithography properties andapplications of thin and LB films.

List of books:

1. Barsoum ,M.W.,Fundamentals of Ceramics,McGraw Hill ,New Delhi
2. Ashcroft ,N.W. and Mermin,N.D.,Solid Stae Physics,Saunders College
3. Callister W.D.,Material Science and Engineering, An Introduction,Wiley
4. Keer,H.H,Principals of Solid State,Wiley Eastern
5. Anderson J.C.,Lever K.D.,Alexander J.M and Rawlings,R.D.,ELBS
6. Gray G.W.Ed.Thermotropic Liquid Crystals,John Wiley
7. Kelkar and Hatz Handbook of Liquid Crystals,Chemie Verlag.
8. Kalbunde K.I.,Nanoscale Materials in Chemistry,John Wiley,NY.
9. Shull R.D.,McMichael R.D. and Swartzendrub L.J.,Studies of Magnetic Properties of Fine particles and their
relevance to Mataerials Science, Elsevier Pub. Amsterdam

PSCChT15: Paper XV (Special II-Inorganic Chemistry)

60h (4h/week) 15h/ unit 80 Marks

Unit-I 15 h

A) Basics of Photochemistry: Absorption, excitation, photochemical laws, quantum yield, electronicallyexcited states-life times-measurements of the times. Flash photolysis, stopped flow techniques, Energydissipation by radiative and no-radiative processes, absorption spectra Frank-photochemical stages-primary & secondary processes.

B) Properties of excited states: Photochemical kinetics,Calculation of rates of radiative processes.

C) Excited States of Metal Complexes: Electronically excited states of metal complexes, charge transferspectra, charge transfer excitations, metods for obtaining charge transfer spectra.

Unit-II 15h

A) Ligand field Photochemistry: photosubstitution, photo oxidation & photoreduction. Liability andselectivity, zero vibrational levels of ground state and excited state, energy content of excited state, zero-zerospectroscopic energy, development of the equations for redox potentials of the excited states.

B) Redox reactions by Excited Metal Complexes: Energy transfer under conditions of weak interaction &strong interaction – exciplex formation, conditions of excited states to be useful as

redox reactants, excitedelectron transfer, metal complexes as attractive candidates (2,2-bipyridine & 1,10-Phenanthrolinecomplexes.), illustration of reducing and oxidizing character of ruthenium (II); role of spin-orbit coupling, lietime of these processes. Application of redox processes of electronically excited states for catalytic purposes,transformation of low energy reactants in to highenergy products, chemical energy in to light.

C) Metal Complex Sensitizers: Metal Complex Sensitizers, electron relay, metal colloid systems, andsemiconductor supported metal or oxide systems, water photolysis, nitrogen fixation & carbon dioxidereduction.

Unit-III 15h

Organotransition Metal Chemistry: Alkyls and Aryls of Transition Metals: Types, routes of synthesis, stability& decomposition pathways of alkyls & aryls of transition metals. Organocopper in Organic synthesis.

Compounds of Transition Metal –Carbon Multiple bonds: Alkylidenes, alkylidynes, low valent carbenes &carbynes–synthesis, nature of bond, structural characteristics, nucleophilic &electrophilic reactions onligands, role inorganic synthesis.

Unit-IV 15h

Transition Metal Pi Complexes-Carbon multiple bonds. Nature of bonding, structural characteristics &synthesis, properties of transition metal pi- Complexes with unsaturated organic molecules, alkenes alkynes,allyl, diene, dienyl, arene & trienyl complexes. Application of transition metal, organometallic intermediatesin oraganic synthesis relating to nucleophilic & electrophilic attack on ligands, role in organic synthesis.

List of books:

1. Elschenbroich Ch.and Salzer A.: Organometallics, VCH,Weinheim, NY.
2. Balzani Vand Cavassiti V.:Photochemistry of Coordination compounds,AP,London
3. Purcell K.F.and KotzJ.C., An Introduction to Inorganic Chemistry,Holt Sounder,Japan.
4. Rohtagi K.K.and Mukharjee,Fundamentals of Photochemistry,Wiley eastern
5. Calverts J.G.and Pits.J.N.,Photochemicals of Photochemistry,John Wiley
6. Wells,Introduction of Photochemistry
7. Paulson,Organometallic Chemistry,Arnold
8. Rochow,Organometallic Chemistry,Reinhold
9. Zeiss,Organometallic Chemistry,Reinhold
10. Gilbert A.and Baggott,J,Essential of Molecular Photochemistry,Blackwell Sci.Pub.
11. Turro N.J.and Benjamin W.A.,Molecular Photochemistry
12. CoxAand Camp,T.P.Introductory Photochemistry,McGraw-Hill
13. KundallR.P.and GilbertA,Photochemistry, Thomson Nelson Coxon J and Halton B.,Organic Photochemistry, Cambridge University Press.

PSCChP10 Practical-X (Inorganic Chemistry Special)
9 h /week Marks: 80

A) Preparation and characterization of following the following complexes/organometallic compoundincluding their structural elucidation by the available physical methods. (Element analysis, molecular weightdetermination, conductance and magnetic measurement and special studies) Selection can be made from thefollowing:

i) Cis and trans isomers of bis(glycinato) copper(II) monohydratye.

ii) N,N-bis (salicylaldehyde) ethylene diaminato nickel(II)

iii) Trinitrotriamine cobalt(III)

iv) Cis and trans disubstituted octahedral Cr (III) complexes $[CrF_2(en)_2]$.

v) Preparation of Grignard reagent

vi) Ferrocene and its acelytion

vii) Sodium amide

viii) Synthesis of trichlorodiphenylantimony(V) hydrate.

ix) Synthesis of metal acetylacetonate: magnetic moment, IR, NMR.

x) Magnetic moment of $Cu(acac)_2H_2O$

xi) Determination of Cr (III) complexes: $[Cr(H_2O)_6]NO_3.3H_2O$, $[Cr(H_2O)_4Cl_2].Cl.2H_2O$, $[Cr(en)_3]Cl_3$

xii) Preparation of N,N bis (salicylaldehyde) ethylenediamine,(salen), Cobalt and copper complexes.

B) Solid State:

1) Preparation of oxides and mixed oxides (Mn_2O_3, NiO, Cu_2O, Fe_3O_4, $ZnFe_2O_4$, $ZnMn_2O_4$, $CuMn_2O_4$ and
$NiFe_2O_4$)

2) Preparation of Silica and Alumina by sol-Gel technique.

3) To study the electrical conductivity of ferrites, Magnetites, doped oxides and pure samples and determineband gap.

C) Bioinorganic Chemistry

1) Extraction and absorption spectral study of chlorophylls from green leaves of students choice

2) Separation of Chlorophyll and their electronic spectral studies.

3) Complexation study of Cu(II) with biologically important amino acids

D) Inorganic reaction mechanism:

Kinetics and mechanism of following reactions:

1) Substitution reactions in octahedral complexes (Acid/Basehydrolysis)

2) Redox reactions in octahedral complexes.

3) Isomerization reaction of octahedral complexes.

E) Inorganic Photochemistry:

i) Synthesis of potassium ferrioxalate and determination of intensity of radiation

ii) photoxidation of oxalic acid by UO2

2+ sensitazation

iii) Photo decomposition of HI and determination of its quantum yield.

List of books:

1. Synthesis and Characterization of Inorganic Compounds, W. L. Jolly, Prentice Hall.
2. Inorganic Experiments, J. Derck Woollins, VCH.
3. Practical Inorganic Chemistry, G. Marrand, B. W. Rockett, Van Nostrand.
4. A Text Book of Quantitative Inorganic Analysis, A. I.Vogel,Longoman.
5. EDTA Titrations. F. Laschka
6. Instrumental Methods of Analysis, Willard, Merit and Dean (CBS, Delhi).
7. Inorganic Synthesis, Jolly
8. Instrumental Methods of Chemical Analysis, Yelri Lalikov
9. Fundamental of Analytical Chemistry, Skoog D.A. andWest D.M Holt Rinehart andWinston Inc.
10. Experimental Inorganic Chemistry, W.G.Palmer, Cambridge.
11. Solid state Chemistry, N.B.Hanney
12. Introduction to Thermal Analysis, TechniquesandApplications,M.E.Brown, Springer
13. Preparation and Properties of solid state Materials, Wilcox, Vol.IandII, Dekker
14. The Structure and Properties of Materials Vol.IV, JohnWulff, Wiley Eastern.

ORGANIC CHEMISTRY SPECIALIZATION
PSCChT14: Paper XIV (Special II-Organic Chemistry)

60h (4h/week) 15h/ unit 80 Marks

Unit I:15 h

A] Carbanions in organic Chemistry Ionization of carbon hydrogen bond and prototopy, Base and acid catalysed halogenation of ketones, ketoenolequilibria, structure and rate in enolisation, concerted and carbanion mechanism for tautomerism,carbanion character in phenoxide and pyrrolyl anions, geometry of carbanions, kinetic and thermodynamiccontrol in the generation of enolates, LDA, hydrolysis of haloforms, use of malonic and acetoacetic esters,Aldol, Mannich, Cannizzaro, Darzens, Dieckmann, Claisen Baylis-Hillman reactions, Knoevenagel, benzoincondensation, Favorski reaction, alkylation of enolates and stereochemistry thereof, Conjugate additions.

B] Organometallic reagents -I

Synthesis and applications of organo Li and Mg reagents, nucleophilic addition to aldehyde, ketones, ester,epoxide, CO_2, CS_2, isocyanates, ketenes, imines, amides, lactones, Stereochemistry of Grignard addition tocarbonyl compounds, o-metallation of arenes using organolithium compounds.

Unit II: 15 h

A] Organometallic reagents-II

Organozinc reagents: Preparation and applications, Reformatsky reaction, Simon-Smith reaction. Organocopper reagents: Preparation and applications in C-C bond forming reaction, mixed oragnocuprates,Gilman's reagent. Organo Hg and Cd reagents in organic synthesis.

B] Transition metals in organic synthesis

Transition metal complexes in organic synthesis-Introduction-oxidation states of transition metals, 16-18 rule,dissociation, association, insertion, oxidative addition, reductive elimination of transition metalOrganopalladium in organic synthesis-Heck reaction, allylic activation, carbonylation, wacker oxidation,isomarization formation N-aryl and N-alkyl bond transmetalation, allyl deprotection in peptides, couplingreactions: Kumada Reaction, Stille coupling, Sonogashira and Suzuki coupling reactions and their importanceApplications of $Co_2(CO)_8$, $Ni(CO)_4$, $Fe(CO)_5$ in organic synthesis. Wilkinson, Noyori, Knowls catalyst of

Rutheniumand Rhodium – synthesis and uses its use in hydrogenation reactions-deallylation, C-C, C-O, C-N bond cleavages.Olefin metathesis by Istand IIndgeneration catalyst, reaction mechanism and application in the synthesis ofhomo and heterocyclic compounds

Unit III: 15 h

A] Advanced Stereochemistry:

Conformation of sugars, monosaccharides, disaccharides, mutorotation, Recapitulation of Stereochemicalconcepts- enantiomers, diastereomers, homotopic and heterotopic ligands, Chemo-, regio-, diastereo- andenantio-controlled approaches; Chirality transfer, Stereoselective addition of nucleophiles to carbonyl group:Re-Si face concepts, Cram's rule, Felkin Anh rule, Houk model, Cram's chelate model. Asymmetric synthesisuse of chiral auxiliaries, asymmetric hydrogenation, asymmetric epoxidation and asymmetric dihydroxylation,

B] Protection and Deprotection of functional groups: Protection and deprotection of functional groups like,hydroxyl, amino, carbonyl and carboxylic acids groups, Solid phase peptide synthesis.

Unit IV: Designing the synthesis based on retrosynthetic analysis 15 h

(A) Disconnection Approach: An introduction to synthons and synthetic equivalents, disconnection approach,functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-Xand two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reactions, aminesynthesis

(B) One Group C-C Disconnections: Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, useof acetylenes and aliphatic nitro compounds in organic synthesis

(C)Two Group C-C Disconnections: Diels-Alder reaction, 1,3-difunctionalised compounds, α,β-unsaturatedcarbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds, Michael additionand Robinson annelation, Methods of ring synthesis

List of books

1] Principle of Organic Synthesis R. O. C. Norman and J. M. Coxon

2] Modern Synthetic Reaction. H. O. House and W. A. Benjamin

3] Organic Synthesis: The Disconnection Approach-S. Warren

4] Designing Organic Synthesis-S. Warren

5] Some Modern Methods of Organic Synthesis-W. Carruthers

6] Advance Organic Reaction. Mechanism and Structure-Jerry March
7] Advance Organic Chemistry Part-B-F. A. Caray and R. J. Sundberg Plenum Press
8] Organic Reaction and their Mechanism-P. S. Kalsi
9] Protective Groups in Organic Synthesis-T. W. Greene
10] The Chemistry of Organo Phosphorous-A. J. Kirbi and S. G. Warren
11] Organo Silicon Compound-C. Eabon
12] Organic Synthesis via Boranes-H. C. Brown
13] Organo Borane Chemistry-T. P. Onak
14] Organic Chemistry of Boron-W. Gerrard

PSCChT15: Paper XV (Special II-Organic Chemistry)

60h (4h/week) 15h/ unit 80 Marks

Unit I: Enzyme chemistry 15h

A] Enzymes: Introduction and historical perspective, chemical and biological catalysis, remarkable propertiesof enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction andpurification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of activesite by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Baker'syeast catalyzed reactions, Applications of enzymes in food and drug chemistry

B] Mechanism of Enzyme Action: Transition-state theory, orientation and steric effect, acid-base catalysis,covalent catalysis, strain or distortion. Example of some typical enzyme mechanisms for chymotrypsin,ribonuclease, lysozyme and carboxypeptidase A.

C] Co-Enzyme Chemistry: Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes.Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+,NADP+, FMN, FAD, lipoic acid, vitamin B12. Mechanisms of reactions catalyzed by the above cofactors.

Unit II: Heterocycles 15h

A] Azoles: Structural and chemical properties; Synthesis of pyrazole, isothiazole and isoxazole; Synthesis ofimidazoles, thiazoles and oxazoles; Nucleophilic and electrophilic substitutions; Ring cleavages

B] Benzofused heterocycles: Synthesis of indole, benzofuran and benzo-thiophene, quinoline and isoquinoline Nucleophilic, electrophilic and radical substitutions; Addition reactions; Indole rings in biology.

C] Diazines: Structural and chemical properties; Synthesis of pyridazines, pyrimidines, pyrazines; Nucleophilicand electrophilic substitutions.

Unit III: 15h

A] Nucleic Acids: Primary, secondary and tertiary structure of DNA; DNA replication and heredity; Structureand function of mRNA, tRNA and rRNA. Purines and pyrimidine bases of nucleic acids and their preparation.

B] Lipids: Fatty acids, essential fatty acids, structures and functions of triglycerols, glycerophospho lipids,spingolipids, lipoproteins, composition and function, role in atherosclerosisProperties of lipid aggregates, micells, bilayers, liposomes and their biological functions, biologicalmembranes, fluid mosaic model of membrane structure, Lipid metabolism, β-Oxidation of fatty acids

C] Vitamins: Structure determination, synthesis and biosynthesis of vitamin A, E and H.

Unit IV: 15h

A] Dyes:

General Introduction, classification on the basis of structure and methos of application dying mechanism,methods of dying, such as direct dying, vat dying, dispersive dying, formation of dye in fibre, dying withreactive dyes, study of quinoline yellow, cyamine dye, ethyl red, methylene blue, Alizarin, cyamine-green,fluorescein, cosin, erythrosine, Rhodomines and Indigo.

B]Pharmaceutical chemistry:

History, medical terms in pharmaceutical chemistry, classification of drugs, antibacterial and antifungal drugs,specific clinical applications, Serendipity and drug development, Synthesis and applications of: Benzocaine,Methyl dopa, dilantin, ciprofloxacin, acyclovir, terfenadine, salbutamol

C] Polymer chemistry: Importance of polymers, Basic concepts: monomers, repeat units, degree ofpolymerization. Linear, branched and network polymers. Classification of polymers. Polymerization:condensation, addition, radical chain-ionic and co-ordination and co-

polymerization and their mechanisms,Polymerization in homogeneous and heterogeneous systems. Ziegler-Natta polymerization with mechanism,Stereo regulated polymers, syndiotactic, isotactic and atactic polymers

List of books

1] Textbook of Polymer Science, F. W. Billmeyer Jr, Wiley
2] Polymer Science, V. R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern
3] Functional Monomers and Polymers, K. Takemoto, Y. Inaki and R. M. Ottanbrite
4] Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer-
Verlag
5] Understanding Enzymes, Trevor Palmer, Prentice Hall
6] Enzyme Chemistry: Impact and Applications, Ed. Collin J. Suckling, Chapman and Hall
7] Enzyme Structure and Mechanism, A. Fersht, W. H. Freeman
8] Introduction to Medicinal Chemistry, A. Gringuage, Wiley-VCH
9] Wilson and Gisvold's Text Book of Organic Medical and Pharmaceutical Chemistry, Ed Robert F. Dorge
10] Burger's Medicinal Chemistry and Drug Discovery, Vol-1, Ed. M. E. Wolff, John Wiley
11] Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley
12] The Organic Chemistry of Drug Design and Drug Action, R. B. Silverman, Academic Press

PSCChP10 Practical-X (Organic Chemistry Special)
9 h /week Marks: 80

[A] Quantitative Analysis based on classical and instrumental technique (any 9-10)
1] Estimation of nitrogen.
2] Estimation of halogen.
3] Estimation of sulphur.
Spectrophotometric/calorimetric and other instrumental methods of estimation
4] Estimation of streptomycin sulphate.
5] Estimation of vitamin B-12.
6] Estimation of amino acids.
7] Estimation of proteins.
8] Estimation of carbohydrates.
9] Estimation of Ascorbic acid.
10] Estimation of Aspirin.
11] Solvent extraction of oil from oil seeds and determination of saponification value, iodine value of the
same oil.
[B] Organic multi-step preparations (Two/Three steps): Minimum 10-12 preparations
[1] Aniline Diaminoazobenzene _ p-aminoazobenzene
[2] Benzoin →Benzyl →Dibenzyl
[3] Aniline → acetanilide → p-bromoacetanilide → p-bromoaniline
[4] Aniline → Acetanilide → p-nitroacetanilide → p-nitroaniline
[5] Benzaldehyde (thiamine hydrochloride) → benzoin → benzil → benzilic acid
[6] p-Nitrotoluene → p-nitrobenzoic acid → PABA → p-iodobenzoic acid
[7] p-Cresol → p-cresylacetate → 2-hydroxy-5-methyl acetophenone → 2-hydroxy chalcone

[8] Benzaldehyde → benzilidene acetophenone → 4,5-dihydro-1,3,5-triphenyl-1H-pyrazole
[9] Aniline → phenylthiocarbamide → 2-aminobenzthiazole (Microwave in step I)
[10] Chlorobenzene → 2,4- Dinitrochlorobenzene → 2,4- Dinitrophenylhydrazine.
[11] Acetophenone → acetophenone phenyl hydrazone → 2-phenylindole
[12] Benzion → benzoin benzoate → 2,4,5-triphenyl oxazole
[13] Benzophenone → benzpinacol → benzopinacolone (Photochemical preparation)
[14] Benzophenone → Benzophenone oxime →Benzanilide →Benzoic acid + aniline
15
[15] Aniline → aniline hydrogen sulphate → sulphanilic acid → Orange II
[16] Aniline → N-arylglycine → indoxyl → indigo
[17] Phthalimide →Anthranilic acid →Phenyl glycine-o-carboxylic acid →Indigo
[18] Phalic anhydride →Phthalimide→ Anthranilic acid →o-chlorobenzoic acid
[19] Phalic anhydride →Phthalimide →Anthranilic acid→Diphenic acid
[20] Ethyl acetoacetate →3-methyl-pyrazol-5-one →4,4-dibromo-3-methyl-pyrazol-5-one→ Butanoicacid
[21] Biosynthesis of ethanol from sucrose
[22] Enzyme catalyzed reactions
[C] SPECTRAL INTERPRETATION
Structure Elucidation of organic compounds on the basis of spectral data (UV, IR, 1H and 13CNMR and Mass)
(Minimum 12 compounds are to be analysed during regular practicals).

PHYSICAL CHEMISTRY SPECIALIZATION

PSCChT14:Special I Paper XIV (Special I-Physical Chemistry)
60h (4h/week) 15h/unit 80 Marks

UNIT-I SURFACE CHEMISTRY 15h

A] Macromolecules: Number and average molecular mass, molecular mass determination:Osmometry,Viscometry, sedimentation, diffusion and light scattering method.

B] Chemical adsorption, application of adsorption, factors affecting adsorption, Langmuir theory, BET theory,heat and entropy of adsorption. Surface film on liquids; Electro-kinetic phenomena. types of adsorptionisotherm. micelle formation, mass action model and phase separation model, shape and structure ofmicelles, CMC, factors affecting CMC effect of added electrolyte on the surface excess of ionic surfactants.

C] Modern techniques for investigating surfaces-Low energy electron diffraction(LEED), PES, Scanningtunneling and atomic force microscopy (STM and AFM)

UNIT II CORROSION AND CORROSION ANALYSIS 15h

A] Scope and economics of corrosion, causes (Change in Gibbs free energy) and types of corrosion,lectrochemical theories of corrosion, dry and wet corriosion, Different types of corrosion-Pit, Soil, chemical

and electrochemical, intergrannular, waterline, microbial corrosion, measurement of corrosion by differentmethods, factors affecting corrosion, passivity, galvanic series, protection against corrosion, design andmaterial selection.

B] Thermodynamics of corrosion, corrosion measurements (Weight loss, OCP measurements, polarizationmethods), passivity and its breakdown, corrosion prevention (electrochemical inhibitor and coatingmethods).

UNIT III: RADIATION CHEMISTRY 15h

Measurement of dose. Dosimetric terms and units (Roentgen, REM, Rad, Gray, Sievert), inter conversions,calculation of absorbed dose-various types of dosimeters, chemical dosimeters (Fricke and Ceric sulphate),experimental methods, TLD badges, Radiolysis-definition, process, Radiolysis of water and aqueous solutions,hydrated electron, Effect of radiation on biological substances, genetic effects, radiation effects on organiccompounds (Halides-carboxylic acids), polymers, nitrates and solid thermoluminescence.

UNIT IV: LIQUID STATE 15h

A] Theory of liquids:- Theory of liquids, partition function method or model approach, single cell models,communal energy and entropy, LTD model, significant structure model.

B] Supercooled and ionic liquids: Supercooled and ionic liquids, theories of transport properties, nonArrhenius behavior of transport properties, Cohen- Turnbull free volume model, configurational entropymodel, Macedo- litovitz model, glass transition in supercooled liquids.

List of Books

1. Y. Moroi, Micelles : Theoretical and Applied Aspects, Plenum Press, New York (1992).
2. E.M. Mc Cash, Surface Chemistry, Oxford University Press, Oxford (2001).
3. P.A. Eglestaff," An Introduction to Liquid State" Academic Press.
4. J.A.Pryde,"The Liquid State"
5. A.F.M.Barton, "The Dynamics of Liquid State", Longman.
6. Introduction to Radiation Chemistry: J. W. T. Spinks and R. J. Woods
7. Radiochemistry: A. N. Nesmeyanov (Mir Publications)
8. G. Hughes- Radiation Chemistry- Oxford University Press, London

PSCChT15: Paper XV (Special II-Physical Chemistry)

60h (4h/week) 15h/unit 80 Marks

UNIT I: ELECTRICAL AND MAGNETIC PROPERTIES OF SOLIDS 15h

A] Metals, insulators and semiconductors, electronic structure of solids-band theory, fermi gas model,electrical conductivity, thermal conductivity, Lorenz number, periodic potential, band structure of metals,insulators and semiconductors, intrinsic and extrinsic semiconductors, doping semiconductors,semiconductor p-n junctions, colors in solids.semiconductors, meissner effect, LTSC, HTSC.

B] Behaviour of substances in magnetic field, effect of temperature: Curie and Curie-weiss law, calculation ofmagnetic moments, magnetic materials, their structure and properties, Applications: structure/ propertyrelations, numericals.

UNIT II: ELECTRICAL PROPERTIES OF MOLECULES 15h

Dipole moments of molecules, basic ideas of electrostatic interactions, polarizability, orientation polarization,Debye equations, limitation of the Debye theory, Clausius-Mossotti equation. electrostatic of dielectricmedium, molecular basis of dielectric behavior, structural information from dipole moment measurements,use of individual bond dipole moments, application to disubstituted benzene derivatives, dipole moment andionic character of a molecule, determination of dipole moment from dielectric measurements in pure liquids
and in solutions. The energies due to dipole-dipole, dipole induced dipole and induced dipole-induced dipoleinteraction. Dispersion, dielectric loss and refractive index. Lennard-Jones potential.

Unit III: LIQUID CRYSTALS 15h

A] LIQUID CRYSTALS :Mesomorpic behavior, thermotropic liquid crystals, positional order, bond orientationalorder, nematic and sematic meso phases, sematic and nematic transitions and clearing temperature,homeotrpic, planer and schlieren textures twisted nematics, chiral nematics, molecular arrngement insmectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptibility and dielectricconstants. Lyotropic phases and their description of ordering in liquid crystals.

B] THIN FILMS: Langmuir- Blodgett (LB) Film, growth techniques, photolithography, properties andapplications of thin and LB films.

Unit IV: 15h

A] Liquid gas and liquid interfaces: Surface tension, methods of determination of surface tension, surfacetension across curved surfaces, vapor pressure of droplet (Kelvin equation) , surface spreading , spreadingcoefficient, cohesion and adhesion energy, contact angle, constant angle hystereis, wetting and detergency.

B] Solid - Solid interfaces : Surface energy of solids, adhesion and adsorption, sintering and sinteringmechanism, Tammann temperature and its importance, surface structure and surface composition.

List of books

1. Physical Chemistry - P.W. Atkin, ELBS fourth edition.
2. Physical Chemistry – R.A. Alberty, R.I. Bilby, Johy Wiley – 1995
3. Physical Chemistry – G.M. Barrow, Tata Mc – Graw Hill – 1988

PSCChP10 Practical-X (Physical Chemistry Special)
9 h /week Marks: 80
Adsorption:
1. To verify Freundlich adsorption isotherm.
2. To verify Langmuir adsorption isotherm.
3. To verify Gibbs adsorption isotherm and to find surface excess concentration of solute.
4. To determine CMC of the given surfactant by surface tension method.
5. Study of variation of surface tension of solution of n-propyl alcohol with concentration and hencedetermine the limiting cross section area of alcohol molecule.
Kinetics:
6. Clock reaction- activation energy of bromide-bromate reaction.
7. Temp dependence of persulfate-iodide reaction by iodine clock method and calculation of thermodynamicand Arrhenius activation parameters. Study of ionic strength effect on persulfate-iodide reaction.
8. Kinetics of B-Z reaction; Kinetics of modified B-Z reaction
9. Investigate the Autocatalytic reaction between potassium permanganate and oxalic acid.
10. Determination of PKa value of a weak acid by chemical kinetic method(formate-iodine reaction)
Potentiometry and Conductometry:
11. Transport number by potentiometry.
12. Hydrolysis constant by aniline-hydrochloride by potentiometry and conductometry
13. pKa of weak acids by potentiometry and conductometry.
14. Complexation between Hg2+and I- conductometrically.

ANALYTICAL CHEMISTRY SPECIALIZATION
PSCChT14: Paper XIV (Special I-Analytical Chemistry)

60h (4h/week) 15h/unit 80 Marks

Unit-I: Radioanalytical Chemistry-II 15h

Preparation of some commonly used radioisotopes, Use of radioactive isotopes in analytical and physicochemicalproblems, Industrial applications, Neutron sources, Neutron Activation Analysis, Isotope DilutionAnalysis, Radiometric titrations (Principle, Instrumentation, applications, merits and demerits),Radiochromatography, Carbon dating, Numericals based on above.

Unit-II: Optical methods of analysis-IV 15h

Inductively coupled plasma-atomic emission spectroscopy: Principle, atomization and excitation. Plasmasource and sample introduction. Instrumentation. Comparison of ICP-AES with AAS. Applications.X-ray fluorescence spectroscopy: Principle. Instrumentation: wavelength and energy dispersive devices.Sources and detectors. Comparison between wavelength and energy dispersive techniques. Samplepreparation for XRF. Matrix effects in XRF. Applications in qualitative and quantitative analysis.Particle induced X-ray emission (PIXE): Basic principle, Instrumentation and applications.Electron microscopy: Principle, instrumentation and applications of scanning electron microscopy (SEM) andtransmission electron microscopy (TEM)

Unit-III: Electrochemical methods of analysis-III 15h

Ion selective electrodes: Theory of membrane potential. Types of ion-selective electrodes. Construction ofsolid state electrodes, liquid membrane electrodes, glass membrane electrodes and enzyme electrodes,Selectivity coefficients, Glass electrodes with special reference to H^+, Na^+ and K^+ ions. Applications of ISE inanalysis of environmentally important anions like F^-, Cl^-, Br^-, I^-, NO_3^- and CN^-. Advantages of ISE.

Coulometry: Principle. Coulometry at constant potential and constant current. Instrumentation. Applicationsand advantages of coulometric titrations.

Electrochemical microscopy: Introduction to scanning probe microscopy (SPM), scanning tunnelingmicroscopy (STM), atomic force microscopy (AFM) and scanning electrochemical microscopy (SECM).

Unit-IV:Thermal methods of analysis 15h

Introduction to different thermal methods, Thermogravimetry (TG and DTG), Static thermogravimetry, quasistaticthermogravimetry and dynamic thermogravimetry, Instrumentation-Balances, X-Y recorder, Stanton-Redcroft TG-750,

Thermogram, Factors affecting thermogram, Applications of thermogravimetry, Differential Thermal Analysis (DTA)-Theories, DTA curves, Factors affecting DTA curve, Applications of DTA, simultaneous determination in thermal analysis,Differential Scanning Calorimetry (DSC)-Introduction, Instrumentation, DSC curves, factors affecting DSC curves,applications, Thermogravimetric titration-Theory, Instrumentation and applications.

PSCChT15: Paper XV (Special II-Analytical Chemistry)

60h (4h/week) 15h/ unit 80 Marks

Unit-I: Pharmaceutical and clinical analysis 15h

Requirements of a quality control laboratory for pharmaceutical units, a general idea about following classesof drugs and their analysisa.

Antibiotics-Chloroamphenol, ampicilline, terramycine

b. Vitamins-Thymine hydrochloride (Vitamin-B1) Riboflavin (Vitamin-B2), Ascorbic acid (Vitamin-C)

c. Sulpha drugs- sulphaguanidine, sulphapyrazine, sulphanilamide

d. Narcotics and dangerous drugs- screening by GC and TLC and spectrophotometric measurements.Composition of blood, sample collection for blood and urine, clinical analysis, Immuno Assay-RIA, Setting upof RIA and applications, Fluorescence Immunoassay, Enzyme immunoassay, Blood gas analyzer, Traceelements in the body.

Unit-II: Soil analysis and coal analysis 15h

Soil analysis- Classification and composition, pH and conductivity, analysis of constitutents such as nitrogen,phosphorous, potassium and microconstitutents.

Coal analysis- Proximate analysis (moisture content, ash content, volatile matter, fixed carbon). Ultimateanalysis (carbon, hydrogen, sulphur, nitrogen, oxygen content). Combustion of carbonaceous fuel- Flue gas.Calorific value and its units.

Unit-III: Corrosion and corrosion analysis 15h

Definition, draw backs and theories of corrosion-dry and wet corrosion, Different types of corrosion-Pit, Soil,chemical and electrochemical, intergrannular, waterline, microbial corrosion, measurement of corrosion bydifferent methods, factors affecting corrosion, passivity, galvanic series, protection against corrosion, designand material selection.

Unit-IV: Automation in analytical chemistry 15h

Automation in the laboratory, Principle of automation, automated instruments, classification, continuousanalyzer, automatic instruments, semiautomatic instruments GeMSAEC Analyzer, Flow Injection Analysis(FIA), Dispersion coefficient, Factors affecting Peak Height, microprocessor based instruments, Numericalsbased on above.

Hyphenated techniques: Introduction to GC-MS, LC-MS, ICP-MS and MS-MS (Tandem) spectrometry.

PSCChP10 Practical-X (Analytical Chemistry Special)

9 h /week Marks: 80

A**. Organoanalytical chemistry**

1. Estimation of sulphur, nitrogen, phosphorous, chlorine in organic compound.
2. Estimation of phenol.
3. Estimation of aniline.

B. **Separation techniques**

Ion exchange

1. Separation and estimation of zinc and magnesium/cadmium in a mixture on anion exchanger.
2. Separation and estimation of chloride and iodide in a mixture on anion exchanger.
3. Determination of total cation concentration in water.

Solvent extraction

1. Estimation of Copper using Na-DDC.
2. Estimation of Iron using 8-hydroxyquinoline.
3. Estimation of Nickel using DMG.
4. Estimation of Cobalt using 8-hydroxyquinoline.
5. Estimation of Nickel by synergistic extraction with 1,10-phenanthroline and dithizone.

Paper chromatography

1. Separation and estimation of copper and nickel in a mixture.
2. Separation and estimation of cobalt and nickel in a mixture.

Thin layer chromatography

Separation and estimation of bromophenol blue, congo red and phenol red in a mixture.

C. Water analysis

Mineral analysis: Ttemperature, pH, conductivity, turbidity, solids, alkalinity, chloride, fluoride, sulphate,

hardness
Demand analysis: DO, COD
Heavy metals: Fe, Cd and Pb
D. Demonstrations
1. Gas chromatography
2. HPLC

List of books:

1. Essentials of Nuclear Chemistry: H. J. Arnikar (Willey Eastern Ltd)
2. Substoichiometry in Radioanalytical Chemistry: J. Ruzicka and J Stary (Pergamon Press)
3. Thermal analysis: Blazek (translated by J. F. Tyson, Van Nostrand)
4. Instrumental Methods of Analysis: Willard, Meriit and Dean(Van Nostrand)
5. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
6. Vogel's Text Book of Quantitative inorganic Analysis: Bassett, Denney, Jeffery and Mendham (ELBS)
7. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
8. Atomic Absorption Spectroscopy: Robinson (Marcel Dekker)
9. Instrumental Methods of chemical Analysis: Braun (Tata McGraw-Hill)
10. Radiochemistry: A. N. Nesmeyanov (Mir Publications)
11. Analysis of Water: Rodier
12. Ion selective electrods: Koryta (Cambridge University Press)
13. Instrumentation in analytical chemistry: Borman (American Chemical Society)
14. Industrial Chemistry: Arora and Singh (Anmol Publications)
15. Diffraction Methods: John Wormald (Clarendon Press)
16. Electroanalytical Chemistry: Bard (Dekker)
17. Analytical Chemistry by Open Learning (Wiley)
18. An Introduction to Electron Diffraction: Beeston (North Holand Publishing Co.)
19. Material Science and Engineering: V. Raghavan (Printice-Hall of India)
20. Practical Physical Chemistry: J. B. Yadav (Goel Publishing House)

PSCChT16 Paper XVI Elective (Applied Analytical Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Water treatment 15h

Hardness of water and types of hardness. Problems due to hardness. Removal of hardness by lime-sodaprocess, Zeolite process and synthetic ion-exchange resins. Principle, instrumentation and comparison ofthese three processes. Numericals based on hardness removal. Desalination of sea-water.

Unit-II: Polymer chemistry and Glass analysis 15h

Polymer chemistry: Definition, classification, co-polymers, conducting polymers, determination of molecularweight, acid value, saponification value, iodine value and hydroxyl groups of polymers., TGA and DTA studiesof polymers, LDC polymers. Rubbers, elastomers, silicones.

Glasses: Introduction. Physical and chemical properties. Composition of ordinary glass and special glasses.Determination of silicon, calcium, magnesium, aluminium, chloride, sulphur, barium, arsenic, antimony,chromium, cobalt, copper, iron, manganese, nickel, titanium in glasses.

Unit-III: Cosmetic technology and leather analysis 15h

Importance of quality control in cosmetic preparations, stability testing of various cosmetic products, Studyof rheological properties of semi-solid preparations, evaluation of active ingredients in finished products likeshampoos, hair dyes, toothpaste, talcum powder, lip sticks, sun screen preparations.Analysis of leather: Determination of moisture, acid, free sulphur, total ash, chromic oxide in leather, tensilestrength and stretch of leather.

Unit-IV: Explosives and propellants 15h

Classification of explosives, characteristics of TNB, TNT, RDX, dynamite, lead azide, ammonium nitrate,ammonium picrate. Pyrotechniques.Analysis of explosives and propellants: Heat of explosion, moisture determination by Karl-Fisher reagent,vacuum oven drying and non-aqueous titration. Stability by different methods. Total volatiles. Qualitativetests for explosives. Colorimetric methods for nitro-compounds. Mechanical tests for explosives.

PSCChT16 Paper XVI Elective(Nuclear Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Radiation Chemistry, Radiolysis 15h

Measurement of dose. Dosimetric terms and units (Roentgen, REM, Rad, Gray, Sievert), inter conversions,calculation of absorbed dose-various types of dosimeters, chemical dosimeters

(Fricke and Ceric sulphate),experimental methods, TLD badges, Radiolysis-definition, process, Radiolysis of water and aqueous solutions,hydrated electron,Effect of radiation on biological substances, genetic effects, radiation effects on organic compounds (Halidescarboxylicacids), polymers, nitrates and solid thermoluminescence

Unit-II: Hot Atom Chemistry and Radiochemistry 15h

Recoil energy and calculations, Szilard Chalmers effects, Kinetics, primary and secondary retention-effect ofvarious factors on retention and its uses, Mossbauer effect- principle, instrumentation and chemical lapplications

Unit-III: Radioanalytical techniques 15h

Neutron sources, Neutron activation analysis, principle, methodology and application for trace analysis,Isotope dilution analysis-principle and application, Isotopic exchange reaction, mechanism and application inuse of radioisotopes and tracers, radioactive dating based on carbon-14 and lead isotopes.

Unit-IV: Radiopharmaceuticals 15h

Radioimmunoassay (RIA), discovery, principle, set up of RIA, Principle of Immunoradiometric assay (IRMA),principle and set up, Radiopharmaceuticlas, classification of products, preparations, quality control aspects,99Mo-99mTc generator, Cylotron based products, PRT studies, Therapeutic applications , Radiotherapy

PSCChT16 Paper XVI (Elective- Environmental Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit-I: Water Pollution 15h

Pollutants- Types of pollutants, sources of water pollution, sampling, preservation and storage of watersample, physico –chemical, organoleptic and chemical analysis of water, electro-analytical, optical (UC-visiblespectrophotometry, AAS, flame photometry, XRF, ICPAES),

chromatographic (GC and HPLC) and neutronactivation methods of analysis of Co, Ni, Cu, Fe, Mn, Zn, Cd, Pb, Hg, As, Cl^- ,F^-, $SO^{4--,}PO^4$-, NO_3^2- Historicaldevelopment of detergents, chemistry of soaps and detergents.

Unit-II: Air Pollution 15h

Natural versus polluted air, air quality standards, air sampling, analysis and control of Particulates, Chemistryand analysis of SOx, NOx, CO, ozone, hydrocarbons, CFCs. Chemistry of gaseous, liquid and solid fuelsgasolineand additives, antiknock agents. Air pollution control—control of automobile emission and controlmeasures in thermal power stations.

Unit-III: Soil Pollution 15h

Types and sources of soil pollution, classification of soil pollutants, impact of soil pollution on air quality,Specifications for disposal of sewage and effluent on land for irrigation and ground water recharge.Methodology of waste water disposal on land in India. Impact of usage of land for solid waste disposal bothmunicipal solid waste and industrial solid wastes (fly ash from thermal power station, lime sludge from paperand pulp industry), cause of soil erosion, effects of soil erosion, conservation of soil, control of soil pollution

Unit-IV: Solid waste pollution 15h

Sources, types and consequences, classification of wastes- domestic, industrial, municipal, hospital, nuclearand agricultural and their methods of disposal. Transfer and transport, Recycle, reuse, recovery, conversionof solid wastes -energy / manure. Analysis and monitoring of pesticides.Impact of toxic chemicals on enzymes, Biochemical effects of As, Cd, Pb and Hg, their metabolism, toxicityand treatment.

PSCChT16 Paper XVI (Elective- Polymer Chemistry)

60 h (4 h per week): 15 h per unit 80 Marks

Unit I: Polymerization 15h

Types of polymerization, addition-chain, free radical, ionic polymerization, step polymerization, electropolymerization, ring-opening polymerization.

Unit II: Techniques of polymerization ` 15h

Techniques of polymerization-suspension, emulsion and bulk polymerization, coordination, polymerizationmechanism of Ziegler Natta polymerization, stereospecific polymerization, interfacial polycondensation,mechanism of polymerization.

Unit III: Characterization of polymers ` 15h

Electronic, IR and NMR spectral methods for characterization of polymers (Block and Graft)

Thermal methods-TGA, DTA, DSC, thermomechanical and X-ray diffraction study, Block and Graft copolymers,random, block, graft co-polymers, methods of copolymerization.

Unit IV: Specific polymers ` 15h

A) Biomedical polymers: Contact lens, dental polymers, artificial heart, kidney and skin.

B) Inorganic polymers: Synthesis and application of silicon, phosphorous and sulphur containing polymers.

C) Coordination polymers: Synthesis and applications of coordination polymers.

PSCChT16 PaperXVI (Elective- Medicinal Chemistry)
60 h (4 h per week): 15 h per unit 80 Marks
UNIT-I: 15 h

A] Drug rules and drug acts, Overview of Intellectual property right, Indian and International framework forpatent protection.

B] Chromatographic separation techniques for drugs: TLC, Paper chromatography, GC, HPLC, LCMS.Dignostic agents: Radio Pharmaceuticals, Radiology and CT.

UNIT-II: 15 h

A]Statastical method: For sampling and interpretation of results, Statastic in quality control, T-Test, F-Test,Validation of analytical methods as defind proceding USP Radioimmunoanalysis, Investigational drugs.

B]Anti-Viral agents: Inroduction, viral diseases, viral replication, and transformation of cells, investigation ofantiviral agents,. Chemotherapy for HIV. Synhesis of: Idoexuidine,acyclovir ,amantadine and cytarabin.

C]Anti-malarial agents: Introduction, malarial parasite, and its life cycle, development of antimalarials,chemotherapy of malaria. Synthesis of: Chloroquin, primaquin, proguanil, and Quinacrine

UNIT-III: 15 h

A) Histamines and Antihistamic agents: Introduction, histamine H1-receptor antagonists. Inhibitors ofhistamine release. Synthesis of: alkyl amines, phenothiazines, piperzines derivatives.

B) Antibiotics: Introduction, β-lactam antibiotics, classification, SAR and chemical degradation of penicillin,cephalosporins-classification , tetracycline antibiotics-SAR,miscellaneous antibiotics. Synthesis of ampicillin,cephradine, methacycline,chloramphenicol

UNIT-IV: 15 h

A) Anthelminitics and antiamoebic drugs: Introduction to Helminthiasis, Anthelminitics, drugs used incestode infection, drugs used in trematode infection, origin of antiamoebic drug, drugs used in nematodeinfection. Synthesis of: Clioquinol, Iodoquinol, Haloquinol, Dichlorphen, Niclosamide.

B) Anti-inflammatory drugs: Introduction, etiology of inflammatory diseases. The inflammatory response,biochemical response. Synthesis of: Phenyl butazone and its derivatives, pyrazolone derivatives, pyrole andindole acetic acid derivatives.

PSCChP11 Practical-XI Project

9 h/week 80 Marks

Project is a part of practical examination. Project should be carried out by the student under the supervision of Guide/Teacher. The examination shall be conducted by External and Internal Examiners. Students are supposed to present their work either on LCD Projector / OHP or blackboard.

The division of marks will be as follows:

External examiner: 40 marks

Internal examiner (Guide/ Teacher): 40 marks

(With Internal Assessment of 20 Marks)
Note: One external examiner shall be appointed for evaluation of group of 6 students.

PSCChP12 Seminar-

2 h /week Marks: 25
Seminar of 30 minutes duration will be a part of internal assessment for 25 marks (1 credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.