

FACULTY OF SCIENCES

SYLLABUS

FOR

M.Sc. Chemistry

(Semester III-IV)

Session: 2016-18



KHALSA COLLEGE AMRITSAR

(An Autonomous College)

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Defaulters will be prosecuted.
(ii) Subject to change in the syllabi at any time.
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Scheme of Courses

Eligibility:-The candidate having passed B.Sc. degree (10+2+3 system of education) with Chemistry as one of the elective subject with at least 50% marks from Guru Nanak Dev University or any other examination recognized equivalent there to by the University.

Semester-III

Course-CH419	Inorganic Chemistry-III (<i>Bioinorganic and Metal Clusters</i>)	75	60
Course-CH420	Organic Synthesis-IV (<i>Asymmetric synthesis, Green Chemistry and Heterocyclics</i>)	50	45
Course-CH421	Physical Chemistry-III (<i>Electrochemistry and Chemical Dynamics</i>)	75	60
Course-CH422	Organic Synthesis-V (<i>Photochemistry & Pericyclic</i>)	50	45
Seminar		Satisfactory/unsatisfactory	
Project/Dissertation:	The project to be allocated in the third semester		
Total:		250	210

Semester- IV

		Max. Marks	Hrs.
Course-CH423	Inorganic Chemistry-IV: (<i>Advanced Inorganic Chemistry</i>)	75	60
Course-CH424	Organic Synthesis-VI (<i>Natural Products</i>)	75	60
Course-CH425	Physical Chemistry-IV (<i>Analytical Techniques</i>)	75	60
Course-CH426	Physical Chemistry-V (<i>Surface and Polymer Chemistry</i>)	75	60
Project/Dissertation		Satisfactory/unsatisfactory	
Total:		300	240

Semester-III

M.Sc. Chemistry (Semester-III)
CH419: Inorganic Chemistry-III
Biinorganic and Metal Clusters

60 hrs.

Time: 3 Hrs.

Max. Marks: 60+15(Internal Assessment)

Instructions for paper setters and candidates

- I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
- II. Examiner will set total of NINE questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
- III. Section-I will consist of eight short questions carrying 1.5 Marks each.
- IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 12 Marks.
- V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

UNIT-I

1. (a) Bioinorganic Chemistry

15

Hrs Periodic survey of essential and trace elements, biological importance and relative abundance, Na⁺/ K⁺ ion pump and its mechanism.

Porphyrine and metalloporphyrins, Oxygen carriers/storage-Hb and Mb: Structure and mechanism of their function, cooperativity and Bohr effect. Synthetic models of Hb, Cyanide, phosphine and carbon monoxide poisoning.

Inhibition and poisoning by ligand and metal ions, hemocyanin and hemerythrin, models of iron, coal and copper.

Bioenergetic and ATP cycle process coupled to phosphate hydrolysis, Nucleotide transfer-DNA polymerase, phosphate transfer pyruvate kinase, phosphoglucomutase, creatin kinase, ATPase.

UNIT-II

1. (b) Bioinorganic Chemistry

15 Hrs

Photosynthesis and respiration - chlorophyll : structure, function and its synthetic model. Xanthine oxidase, Gout Disease and its remedy.

Enzymes and their functioning, Bioredox agents, Zn-enzymes carboxipeptidase, carbonic anhydrase, superoxide dismutase, peroxidases and catalases,

Vitamin B₁₂ coenzyme, structure, function and "Mn" mechanism and its application in organic synthesis, intake of alcohol and its remedy.

Cytochromes-structure and function, Cytochrome P₄₅₀ enzymes.

Ferredoxins and rubredoxins their structure and function. Abiological and biological N₂ fixation and mechanism.

UNIT-III

1. (c) Bioinorganic Chemistry

15 Hrs

Ferritin, transferrin and siderophores and their structure and function.

Availability, competition, toxicity and nutrition of Iron, metal deficiency and diseases, toxic effects of antibiotics, chelate therapy, synthetic metal chelates as antimicrobial agents.

Calcium in living cell, transport and regulation and its mechanism.

Molecular aspects of intramolecular processes and their mechanisms.

2. Metal Clusters

(a) Reaction at Coordinated ligands

The role of metal ions in the hydrolysis of amino acid esters, peptides, and amides Molecular orbital concept of role of metal ions participation, Modified aldol condensation, Imine formation, Template and Macrocyclic effect in detail.

UNIT-IV

(b) Metal to Metal Bonds and Metal atom Clusters

15 Hrs

Metal carbonyl clusters, isoelectronic and isolobal relationship, high nuclearity carbonyl clusters (HNCC), Structural Patterns, synthetic methods, heteroatoms in metal atom clusters

Carbide and nitride containing clusters, electron counting scheme for HNCC's, the capping rule, HNCC's for Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt.

Lower halides and chalcogenides clusters, octahedral metal halides and chalcogenides clusters ($M_6M_8M_6M_{12}$ type).

Several phases, triangular clusters and solid state extended arrays. Compound with M-M multiple bonds, major structural types, quadruple bonds, other bond orders.

Intracluster relation of clusters to multiple bonds and one dimensional solids.

Books Recommended:

1. Principles of Bioinorganic Chemistry, S. J. Lippard and Berg, University Science Books.
2. J.E. Huheey : Inorganic Chemistry III & IV Ed. Pearson Education Asia – (2002).
3. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 5th Edition.
4. Purcell and Kotz: Inorganic chemistry. W. B. Saunders and Co., London
5. Bioinorganic Chemistry by D. Banerjee

M.Sc. Chemistry (Semester- III)
CH420: Organic Chemistry-IV
Asymmetric synthesis, Green Chemistry and Heterocyclic Chemistry

45 hrs.

Time: 3 Hrs.

Max. Marks: 40+10(Internal Assessment)

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UNIT-I

1. Asymmetric Synthesis

(a) General Aspects

4Hrs

Introduction, Analytical methods for determination of enantiomeric purity – GC, HPLC and NMR. Natural sources of chiral starting materials, classification and methods of formation of new chiral compounds.

(b) Non-Enzymatic Approaches towards asymmetric synthesis

6Hrs

Methods of asymmetric synthesis using chiral pool synthesis, auxiliaries, chiral reagents and catalysts, Asymmetric carbon-carbon bond formation using alkylation, Michael reaction and addition to carbonyl compounds. Cram's rule and Felkin-Ahn model. Asymmetric oxidation and reductions.

UNIT-II

2. Enzymatic approach towards asymmetric synthesis

7Hrs

Biotransformations: Nomenclature and Classification of enzymes, advantages and disadvantages, Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis-menten and Lineweaver-Burk plots, reversible and irreversible inhibition. Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion.

3. Reaction Catalysed by Enzymes

5Hrs

Nucleophilic displacement on a phosphorus atom, multiple displacement reaction and the coupling of ATP cleavage to endergonic processes. Transfer of sulphates, addition

and elimination reactions, enolic intermediates in isomerization reactions, Enzyme catalyzed carboxylation and decarboxylation.

UNIT-III

4. Co-Enzyme Chemistry 4Hrs

Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological function of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD⁺, NADP⁺, FMN, FAD, vitamin B₁₂.

5. Green Chemistry approach towards synthesis 7Hrs

Principles and concepts of Green Chemistry, atom economic and uneconomic reactions, source and minimizing techniques of waste from chemical industry, homogeneous and heterogeneous catalysis, phase transfer catalysis, biocatalysis and photocatalysis. Principles of ultrasound and microwave assisted organic synthesis. Reactions in ionic liquids and other environmentally benign solvents, Future Prospects.

UNIT-IV

6. Heterocyclic Synthesis

(a) Introduction 2Hrs

Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reaction.

(b) Small Ring Heterocycles 2Hrs

Three-membered and four-membered heterocyclic –synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes

(c) Six-Membered Heterocycles with one Heteroatom 4Hrs

Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and pyridones. Synthesis and reactions of quinolizinium and benzopyrylium salts, coumarins and chromones.

(d) Seven-and Large-Membered Heterocycles 4Hrs

Synthesis and reactions of azepines, oxepines, thiepinines, diazepines, thiazepines, azocines, diazocines, dioxocines and dithiocines.

Recommended Books:

1. Asymmetric Synthesis: The Essentials, Volume 1 Mathias Christmann, Stefan Bräse Wiley, 2008.
2. Principles of Biochemistry by Lehninger
3. Green Chemistry: An Introductory Text by Mike Lancaster, Royal Society of Chemistry, 2002
4. Principles of modern heterocyclic chemistry by Leo A. Paquette
5. Principles of Biochemistry By Voet and Voet

M.Sc. Chemistry (Semester- III)
CH421: Physical Chemistry-III
Electrochemistry and Chemical Dynamics

60 hrs.

Time: 3 Hrs.

Max. Marks: 60+15(Internal Assessment)

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UNIT-I

1.Electrochemistry

15Hrs

Electrochemistry of solutions, Debye-Huckel-Onsager treatment and its extension, ion-solvent interactions, Debye-Huckel-Bjerrum mode, Thermodynamics of electrified interface equation, Derivation of electro-capillarity, Lipmann equation(surface excess), method of determination, structure of electrified interfaces, Guoy-Chpmann, Stern models, overpotential, exchange current density, derivation of Butler-Volmer equation, Tafel plot.

Semiconductor interface theory of double layer at semiconductor electrolyte solution interface, structure of double layer interfaces, effect of light at semiconductor solution interface. Introduction to corrosion, homogeneous theory, forms of corrosion, corrosion monitoring and prevention.

UNIT-II

2.(a)Chemical Dynamics

15Hrs

Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius theory and activated complex theory, ionic reactions, kinetic salt effects,, treatment of uni molecular reactions, Lindemann-Hinshelwood theory.

UNIT-III

2.(b)Chemical Dynamics

15Hrs

Dynamic Chain (hydrogen bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), Photochemical reactions between hydrogen-bromine and hydrogen-chlorine, oscillatory

reactions (Belousov-Zhabotinsky reactions), Homogeneous catalysis and kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, , relaxation method, flash photolysis, nuclear resonance.

UNIT-IV

3.Voltmometry and Polarography

15Hrs

Polarography, polarographic cells, polarogram, interpretation of polarographic waves, equation for the polarographic waves, effect of complex formation on polarographic wave, polarograms for irreversible reactions, dropping mercury electrode, current variations during life time of a drop, merits and demerits of dme, polarographic diffusion currents, Ilkovic equation, capillary characteristics, temperature, polarograms for mixture of reactants, anodic and cathodic waves, factors affecting polarographic currents, applications of polarography, treatment of data, organic and inorganic polarographic analysis, voltammetry at solid electrodes, cyclic voltammetry and interpretation of data, , pilot-ion and standard addition method for quantitative analysis.

Books Recommended:

1. Chemical Kinetics, K. J. Laddler, McGraw-Hill
2. Modern Electrochemistry Vol.1,2,3, J. Bochriss and A.K.N. Reddy
3. Fundamentals of electrochemistry; P. Monk
4. Principles of Instrumental Analysis; Skoog, West; Saunders Publications

M.Sc. Chemistry (Semester-III)
CH422: Organic Synthesis-V
Pericyclic and Photochemistry

45 hrs.

Time: 3 Hrs.

Max. Marks: 40+10(Internal Assessment)

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- IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 8 Marks.
- V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

UNIT-I

1. (a) Pericyclic Reactions

12 Hrs

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene, allyl system, classification of pericyclic reactions FMO approach. Woodward-Hoffmann correlation diagrams method and Perturbation of molecular orbital (PMC) approach for the explanation of pericyclic reactions under thermal and photo-chemical conditions.

Electrocyclic reactions – conrotatory and disrotatory motions, $4n$, $4n+2$, allyl systems secondary effects. Cycloadditions – antarafacial and suprafacial additions, notation of cycloadditions ($4n$) and ($4n+2$) systems with a greater emphasis on ($2+2$) and ($4+2$) cycloaddition-stereochemical effects and effects of substituents on the rates of cycloadditions, 1,3-dipolar cyclo-additions and cheletropic reactions.

UNIT-II

1. (b) Pericyclic Reactions

10 Hrs

Sigmatropic Rearrangements-suprafacial and antarafacial shifts [1,2]- sigmatropic shifts involving carbon moieties retention and inversion of configuration, (3,3) and (5,5) sigma-tropic rearrangements, detailed treatment of Claisen and Cope rearrangements, fluxional tautomerism, aza-cope rearrangements, introductions to Ene reactions, simple problems on pericyclic reactions. Electrocyclic rearrangement of cyclobutenes and 1,3-cyclohexadienes.

UNIT-III

2. Photochemistry

(i) Photochemical Reactions

3 Hrs

Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry.

(ii) Determination of Reaction Mechanism

3 Hrs

Classification, rate constants and life times of reactive energy states –determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions.

Types of photochemical reactions – photodissociation, gas-phase photolysis.

(iii) Photochemistry of Alkenes

5 Hrs

Intramolecular reactions of the olefinic bond – geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1, - dienes.

UNIT-IV

(iv) Photochemistry of Carbonyl Compounds

6 Hrs

Intramolecular reactions of carbonyl compounds – saturated, cyclic and acyclic, β , γ - unsaturated and α,β -unsaturated compounds, Cyclohexadienones. Intermolecular cycloaddition reactions – dimerisations and oxetane formation.

(v) Photochemistry of Aromatic Compounds

3 Hrs

Isomerisations, additions and substitutions.

(vi) Miscellaneous Photochemical Reactions

3 Hrs

Photo-Fries reactions of anilides. Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision.

Books Recommended:

1. Pericyclic reactions: A Mechanistic study by S. M. Mukherji
2. The Conservation of Orbital Symmetry by R. B. Woodward and R. Hoffman
3. Organic Photochemistry – Chapman and Depuy.
4. Organic Photochemistry – W.H. Horsepool.
5. Photochemistry of Excited States – J.D.Goyle.
6. Fundamentals of Photochemistry by K.K. RohtagiMukherji

Semester-IV

M.Sc. Chemistry (Semester-IV)
CH423: Inorganic Chemistry-IV
Advanced Inorganic Chemistry

60 hrs.

Time: 3 Hrs.

Max. Marks: 60+15(Internal Assessment)

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UNIT-I

1. Photoinorganic chemistry

17Hrs

Basics of photochemistry, Absorption, excitation, photochemical laws, quantum yield, electronically excited states, life times, measurements of the times, flash photolysis, energy dissipation by radiative and non-radiative processes, absorption spectra, Franck-Condon principle, photochemical stages- primary and secondary processes, Kasha's rules, excited states, photosubstitution reactions, Adamson's rules, photo substitution reactions of Cr(III) and Ru polypyridyles. Rh(III) ammine complexes. Ligand photoreactions, photoredox reactions, comparison of Fe²⁺ and Ru²⁺ complexes. Photo reactions and solar energy conversion, photosynthesis in plants and bacteriochlorophyll synthesis, photolysis of water using inorganic precursors.

UNIT-II

2. Oxidative addition and Insertion reactions

15Hrs

Acid base behavior of metal atom in complexes, protonation and Lewis base behavior, acceptor properties of Lewis acidity of complexes, oxidative and reductive elimination and their mechanism, addition of specific molecules, H₂, HX and organic halide addition of some other molecules, reductive elimination, migration reactions their types, promotion of alkyl migration, insertion of CO into M-H bonds, other aspects of CO insertion reactions, transfer of other molecules, CO₂, SO₂, NO₂, RCN.

UNIT-III

3. Transition metal compounds with hydrogen and oxad reactions

13Hrs

Insertion of alkenes and C-C unsaturated compounds, cleavage of C-H bonds, alkane activation. Cyclometallation reactions in detail, reactions of free hydrocarbons.

Characteristics of hydride complexes, synthetic methods, chemical behavior of H⁻ complexes, mononuclear and homoleptic polyhydride anions, carbonyl H⁻ and anion H₂ compounds, M-H interactions. Complexes of boron and aluminium hydrides, synthetic applications of metal hydrides.

UNIT-IV

4. Structure and bonding of d-Block elements

15Hrs

Pervoskite, Ti(NO₃)₄, TiCl₄(diars)₂, [Ti(OEt)₄]₄, Zr(BH₄)₄, [M₆X₁₂]⁺ (M= Nb & Ta; X= halide); VO(acac)₂; VOCl₂(NMe₃)₂, [Nb(n⁵-C₅H₅)H-□ (n⁵,n¹-C₅H₄)₂]; Isopoly and heteropoly acids of MO, W & V; [M₆X₈]⁴⁺ M= MO & W; CrO(O₂) (bipy); [MO₂O₄(C₂O₄)₂ (H₂O)₂]²⁺; [W₃O₂ (O₂CMe)₆ (H₂O)₃]²⁺; [Cr₃O(O₂CMe)₆ L₃]⁺; [H₂W₂(CO)₉]²⁺; Re₃Cl₉; [ReH₉]³⁺; ReCl₆(Pet₃)₂; Re₂Cl₆(PEt₃)₂; Re₂Cl₅ (DTH)₂, Roussin's salts; [Ir₃O(SiO₄)₉]¹⁰⁻; [Ir₃N(SiO₄)₆(H₂O)₃]⁴⁻; [Co(acac)₂]₄, α and β-MCl₂ (M=Pd,Pt); Wolfram's salt; [Ni(acac)₂]₃; Ni(Me₆-acac)₂; Ni (Me-sal)₂; [Cren₃] [Ni(CN)₅] 1.5 H₂O; [Ni (CN)₂ (NH₃)]₂. xC₆H₆; [Pd(O₂CMe)₂]₃, [Pt(O₂CMe)₂]₄; [PtMe₃(acac)]₂; helical chian of AuF₃, Silver (III) ethylenedibiguanide ion; [CuXL]₄ X=halide, L = P or As Ligand; [Au₃Cl₂(PMe₂Ph)₁₀]³⁺; [Zn(acac)₂]₃; [Cd{S=C(NHCH₃)₂]₂(SCN)₂]; Hg(NH₃)₂Cl₂

Books Recommended:

1. Chemistry of Elements by N. N. Greenwood and Earnshaw, Pergamon Press
2. W. W. Portfield: Inorganic Chemistry: A Unified approach
3. Cotton and Wilkinson: Advanced inorganic Chemistry: Vth edition

M.Sc. Chemistry (Semester-IV)
CH424: Organic Synthesis-VI
Natural Products

60 hrs.

Time: 3 Hrs.

Max. Marks: 60+15(Internal Assessment)

Instructions for paper setters and candidates

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- IV. Section-II, III, IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 12 Marks.
- V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and one question from each section i.e. II, III, IV and V.

UNIT-I

1. Studies on Biosynthetic Pathways of Natural Products

10 Hrs

- a) The acetate hypothesis, poly-ketoacids, their addol type cyclisations and meta orientations of hydroxyl groups in naturally occurring phenols.
- b) Isoprene rule, mechanism of formation of mevalonic acid from acetyl coenzyme, Biogenetic isoprene rule. Geranyl pyrophosphates and its conversion into alphapinene, thujene and borneol. Farnesyl pyrophosphate, geranyl, geranyl pyrophosphate and mechanistic considerations for their interconversions into cadinene and abietic acid.

2. Terpenoids

5 hrs

General classification, General Methods of structure determination, Chemistry of Camphor, Abietic acid, Santonin biosynthetic studies on tri and tetra terpenoids.

UNIT-II

3. Carbohydrates

8 Hrs

Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars, N-acetylmuramic acid, sialic acid, disaccharides and polysaccharides. Structural polysaccharides-cellulose and chitin. Storage polysaccharides – cellulose and chitin. Storage polysaccharides-starch and glycogen. Structure and biological functions of glucosaminoglycans or mucopolysaccharides. Carbohydrate metabolism-Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway.

4. Amino-acids, Peptides and Proteins

8 Hrs

Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins, forces responsible for holding of secondary structures. α -helix, β -sheets,

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

Amino- acid metabolism-degradation and biosynthesis of amino acids, sequence determination: chemical/enzymatic/mass spectral, recemization/detection. Chemistry of oxytocin and tryptophan releasing hormone (TRH)

UNIT-III

5. Nucleic Acids

6 Hrs

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

6. Steroids

5 Hrs

General biosynthetic studies on steroids, chemistry of Cholesterol, cortisone, progesterone, oestrone, transformations in steroid molecules.

7. Alkaloids

5Hrs

Classification, chemistry of nicotine, quinine, papaverine, morphine and reserpine.

UNIT-IV

6. Haemin and Chlorophyll

5Hrs

Structure and synthesis of Porphyrins. Chemistry of Haemin and chlorophyll.

7. Antibiotics

5Hrs

Introduction, chemistry of pencillins, streptomycines, chloromphenicol, tetracyclins.

8. Prostaglandins

3Hrs

General study, nomenclature, structure of PGE and synthesis of PGE1, PGE2, PGF2x

Books Recommended:

1. Primary Metabolism: A Mechanistic Approach by J. Staunton, Oxford University Press, 1978.
2. Secondary Metabolism by J. Mann, Oxford University Press, Oxford, 1980.
3. Natural Product Chemistry - A mechanistic, Biosynthetic and Ecological Approach by Kurt B. G. Torssell, Swadish Pharmaceutical Society, 1997.
4. Principles of Biochemistry by A. L. Lehninger, CBS Publishers, New Delhi.
5. Fundamental of Biochemistry by D. Voet, J.G. Voet and C.W. Pratt, John Willey & Sons Inc., New York, 1999.

M.Sc. Chemistry (Semester-IV)
CH425: Physical Chemistry-IV
Analytical Techniques

60 hrs.

Time: 3 Hrs.

Max. Marks: 60+15(Internal Assessment)

Instructions for paper setters and candidates

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UNIT-I

1.(a) Potentiometric Methods

15Hrs

Reference electrodes: Calomel electrodes, silver- silver chloride electrodes, precautions in the use of reference electrodes, metallic indicator electrodes and its types, metallic redox indicators, membrane indicator electrodes, classification of membranes, properties of ion-selective electrodes, the glass electrodes for pH measurement, composition and structure of glass membrane, the hygroscopicity of glass membrane, conduction across glass membrane, the membrane potential, the boundary potential, the potential of glass electrode, the alkaline error, the glass electrodes for other cations, crystalline membrane electrode and their conductivity, the fluoride electrode, the electrode based on silver salts.

UNIT-II

1.(b) Potentiometric Methods

8Hrs

Direct potentiometric measurement, sign conventions, the electrode calibration method, calibration curves for concentration measurements, potentiometric pH measurements with a glass electrode, errors affecting pH measurements with glass electrode.

2. Thermal Methods

7Hrs

Thermogravimetric methods(TG) :Instrumentation, The balance, Furnace, instrument control, applications, Differential thermal analysis(DTA), instrumentation, general principles, applications, Differential scanning calorimetry(DSC), applications.

UNIT-III

3.Coulometric Methods

15Hrs

Current-Voltage relationships during an electrolysis, operation of a cell at a fixed applied potential, initial thermodynamic potential, estimation of required potential, current changes during an electrolysis at constant applied potential, potential changes during an electrolysis at constant applied potential, constant current electrolysis, electrolysis at a constant working electrode potential, An introduction to coulometric methods of analysis, units for quantity of electricity, types of coulometric methods, applications, coulometric titrations, applications of coulometric titrations, comparison of coulometric and volumetric titrations.

UNIT-IV

4. An Introduction to Chromatographic Separations

15Hrs

General description of chromatography, classification of chromatographic methods, Elution chromatography on columns, chromatograms, effect of migration rates and band broadening on resolution, Migration rates of species, partition coefficients, retention time, relationship between retention time and partition coefficients, the rates of solute migration(capacity factor), differential migration rates, the shape of chromatographic peaks, methods for describing column efficiency, definition of plate height, experimental evaluation of H and N, kinetic variables affecting band broadening, relationship between plate height and column variables.

Books Recommended:

- 1.Solid State Chemistry : A.R.WEST
- 2.Principles of Instrumental Analysis: Skoog and West
- 3.Principles of Instrumental Analysis : Willard, Merit and Dean

M.Sc. Chemistry (Semester-IV)
CH426: Physical Chemistry-V
Surface and Polymer Chemistry

60 hrs.

Time: 3 Hrs.

Max. Marks: 60+15(Internal Assessment)

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UNIT-I

1. Adsorption

15Hrs

Surface tension, capillary action, pressure difference across curved surface (Laplace equations), Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids (Electro-kinetic phenomena), catalytic activity at surfaces.

UNIT-II

2. Micelles

15Hrs

Surface active agents, classification of surface active agents, micellization, hydrophobic interactions, critical micellar concentration (CMC), factors affecting CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization, solubilization, micro emulsion, reverse micelles, applications of microemulsions.

UNIT-III

3. Macromolecules

15Hrs

(a) Polymer – definition, Different classifications of polymers, Linear, branched and network polymers. Basic concepts: monomers, repeat units, degree of polymerization. Types of polymers: electrically conducting polymers, Doping of polymers, mechanism of conduction, polarons and bipolarons, fire resistant, liquid crystal polymers, Molecular mass: number, mass and viscosity average weights; Molecular mass determination (osmometry, viscometry, diffusion and light scattering methods), sedimentation, chain configuration of macromolecules, kinetics of polymerization, thermodynamics of polymerization. calculations of average dimensions of various chain structures. Importance of polymers,

Polymerization: condensation, addition, radical chain-ionic and co-ordination and copolymerization. Polymerization conditions and polymer reactions. Polymerization in homogenous and heterogeneous systems.

UNIT-IV

(b) Structure and Properties:

15Hrs

Polymer structure and properties-crystalline melting point T_m -melting point of homogenous series, effect of chain flexibility and steric factors, entropy and heat of fusion. The glass transition temperature, T_g -Relationship between T_m and T_g , effects of molecular weight, diluents, chemical structure, chain topology, branching and chain linking. Property requirements and polymer utilization.

Books Suggested:

1. Physical Chemistry, P. W. Atkins.
2. Textbook of polymer science, F. W. Billmeyer Jr. Wiley.
3. Polymer science, V. R. Gowariker, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern.
4. Polymer Chemistry, Melcolm P. Stevens, Oxford University Press.
5. Physical chemistry of polymers, A. Tager, Mir Publisher, Moscow.