FACULTY OF SCIENCES

SYLLABUS

FOR

M.Sc. Chemistry

Session: 2018-19
(Semester III-IV)

ESTD. 1892

KHALSA COLLEGE AMRITSAR

(An Autonomous College)

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			
Subject Code	**Subject**	**Max. Marks**	**Hrs**
Course-CH417	Inorganic Chemistry-III: (*Bioinorganic and Metal Clusters)*	50	45
Course-CH418	Organic Synthesis-IV (*Natural Products)*	50	45
Course-CH419	Physical Chemistry-III *(Electrochemistry and Chemical Dynamics)*	75	60
Course-CH420	Organic Synthesis-V (*Pericyclic & Photochemistry)*	50	45
Course-CH421	Physical Chemistry-IV *(Analytical Techniques)*	50	45
Course-CH422	Organic Chemistry Lab- II	100	60
Course-CH423	Physical Chemistry Lab-II	100	60
TOTAL		**475**	**360**
Allocation of Project and Literature Survey			

Semester- IV			
Subject Code	**Subject**	**Max. Marks**	**Hrs**
Course-CH424	Inorganic Chemistry-IV: *(Advanced Inorganic Chemistry)*	75	60
Course-CH425	Organic Synthesis-VI (*Asymmetric synthesis, Green Chemistry and Heterocyclic Chemistry)*	75	60
Course-CH426	Physical Chemistry-V *(Surface and Polymer Chemistry)*	75	60
TOTAL		**225**	**180**
Experimental Project Handling and its Presentation			

Distribution of Marks

SNo.	**Semester**	**Total Marks**
1	Semester-I	475
2	Semester-II	500
3	Semester-III	475
4	Semester-IV	225
Grand Total		**1675**

Semester-III

M.Sc. Chemistry (Semester-III)
CH417: Inorganic Chemistry-III
Bioinorganic and Metal Clusters

45 hrs. **Time: 3 Hrs.**
Max. Marks: 40+10(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 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 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)Bioinorganic Chemistry **12 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, coalt 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 **11 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 B_{12} coenzyme, structure, function and "Mn" mechanism and its application in organic synthesis, intake of alcohol and its remedy.

Cytochromes-structure and function, Cytochrome P_{450} enzymes.

Ferrodoxins and rubredoxins their structure and function. Abiological and biological N_2fixation and mechanism.

UNIT-III

1. (c)Bioinorganic Chemistry **11 Hrs**

Ferritin, transferring and siderophores and their structure and function.
Availability, competition, toxicity and nutrition of Iron, metal deficiency and diseases, toxic effects of antibiotics, chealte 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 **11 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 chalcogenidesclusters($M_6M_8M_6M_{12}$ type).
Cheveral phases, triangular clusters and solid state xtended arrays. Compound with M-M multiple bonds, major structural types, quadruple bonds, other bond orders.
Intragoonal context 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. Banergia

M.Sc. Chemistry (Semester-III)

CH418: Organic Synthesis-IV

Natural Products

45 hrs. **Time: 6 Hrs.**

Max. Marks: 40+10(Internal Assessment)

Instructions for paper setters and candidates

I. Examiner will make five sections of paper namely Section-I, II, III, IV and V
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III. Section-I will consist of eight short questions carrying 1.0 Mark 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 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. Studies on Biosynthetic Pathways of Natural Products **8 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 acctyl 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 **4 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 **6 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.Storae polysaccharides – cellulose and chitin.Storate 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 **5 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 **5 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 **3 Hrs**

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

7. Alkaloids **3Hrs**

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 **3Hrs**

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- III)
CH419: Physical Chemistry-III
Electrochemistry and Chemical Dynamics

60 Hrs. **Time: 8 Hrs.**
Max. Marks: 60+15(Internal Assesment)

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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 ecess), 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.Voltmametry 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. Bochris and A.K.N. Reddy
3. Fundamentals of electrochemistry; P. Monk
4. Principles of Instrumental Analysis; Skoog, West; Saundres Publications

M.Sc. Chemistry (Semester-III)

CH420: Organic Synthesis-V

Pericyclic and Photochemistry

45 hrs. **Time: 4 Hrs.**

Max. Marks: 40+10(Internal Assesment)

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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 he explanation of pericyclic reactions under thermal and photo-chemical conditions.

Electrocyclic reactions – controtatory and disrotatory motions, 4n, 4n+2, allylsystems secondary effects.Cycloadditions – antrafacial and suprafacial additions, notation of cylcoadditions (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 cheleotropic reactions.

UNIT-II

1. (b)Pericyclic Reactions **10 Hrs**

Sigmatropic Rearrangements-suprafacial and antrafacial shifts [1,2]- sigmatropic shifts involving carbon moieties retention and invertion 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. Elecrocyclic rearrangement of cyclobutenes and 1,3cyclohexadienes.

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, - dinenes.

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

M.Sc. Chemistry (Semester-III)

CH421: Physical Chemistry-IV

Analytical Techniques

45 hrs. **Time: 4 Hrs.**

Max. Marks: 40+10(Internal Assessment)

Instructions for paper setters and candidates

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UNIT-I

1.(a) Potentiometric Methods **11Hrs**

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 and 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 **06Hrs**

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 **06Hrs**

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 **11Hrs**

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 **11Hrs**

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-III)
CH422: Organic Lab-II
Advanced Organic Chemistry Practical

60 hrs. **Time: 6 Hrs.**
Max. Marks: 80+20(Internal Assesment)

1. Synthesis and Reactivity of benzalacetophenone
   a. Bromination (Electrophilic additions) & subsequent debromination (Elimination)
   b. Epoxidation (Cycloaddition, nucleophilic) and ring opening with hydroxide ion.
   c. Michael addition of aniline.
   d. Conversion of benzalacetophenone to its oxime (nucleophilic addition at C=O)
   e. Conversion of oxime to amide (Beckmann rearrangement) and oxazole
   (Understand the reactivities at conjugated C=O and C=C) bond.

1. Synthesis of Cyclohexene from cyclohexanol and its conversion to 1, 2- *cis*and 1, 2- *trans*-cyclohexanediols.
   a. Epoxidation with peracid (Cycloaddition) and *anti*- ring opening with sodium hydroxide to *cis*- cyclohexane -1, 2- diol.
   b. Dihydroxylation with $KMnO_4$
   (Mechanism of *syn*- and *anti*-cyclohexane-1,2-diol)

2. Preparation and characterization of the Aldol-dehydration products from various combinations of aromatic aldehydes and ketone. Effect of substituents on aromatic aldehydes on the product distribution.
   a. Aldehyde:benzaldehyde, 4-methylbenzaldehyde. 4-methoxybenzaldehyde.
   b. Ketone: acetone, cyclopentanons, cyclohexanone (Book 4).

Recommended Books:

1. An Introduction to Modern Experimental Organic Chemistry, R.M. Roberts, J.C. Gilbert, L.B. Rodewald and A.S Wingrove, Holt Rinehart and Winston Inc, New York. 1969.
2. Vogel's Text Book of Practical Organic Chemistry.
3. Laboratory Experiments on Organic Chemistry, R. Edemas, J.R. Johnson and C.F. Wilcox, The Macmillan Limited, London, 1970.
4. Modern Projects and Experiments in Organic Chemistry, J.R. Mohrig, C.N. Hammonad, P.F. Schatz and T.C. Morrill, W.H. Freeman and Company, New York 2003.

M.Sc. Chemistry (Semester-III)

CH423: Physical Chemistry Lab-II

Electroanalytical Techniques

Max. Marks: 80+20(Internal Assesment) **Labs Hrs.: 60**

1. To determine the partial molar volume of
(a) Glycine (b) Urea using dialtometer

2. To determine the partial molar volume of
(a) methanol (b) n-propanol using dilatometer

3. To determine the surface tension (double cabillary) of mixture of solid and water by deferential method and hence find out parachor of the mixture.

4. To determine the specific and molar refractivity of n-propanol, butanol, hexane and carbon tetrachloride and calculate refraction equivalents of C, H and Cl.

5. To determine the molar refracitivity of water, DMF, dioxane and mixtures of water, DFM, water-Dioxane and verify the refractivity rule. Predict about the interactions between components of mixture by plotting graph between refractive index and mole fraction.

6. To determine the equivalent conductance of weak electrolyte acetic at infinite dilution usingKohlrausch law.

7. Determine equivalent conductance of strong electrolyte at several concentrations and hence verifyonsagars equation.

8. Determine equivalent conductance of weak electrolyte, say, acetic acid at different concentrations and hence test validity of Oswald's dilution law. Also determine dissociation constant of the electrolyte.

9. To determine dissociation constant of a dibasic acid potentiometrically.

10. To study complex formation between Fe(III) and salicylic acid and find out the formula of the complex spectrophotometrically.

11. To determine the formula of the complex ion formed between Fe(III) and Thiocyante ion by Job's method.

12. To study the kinetics of hydrolysis of crystal violet spectrophotometrically.

13. To determine the pH of a buffer solution (*p*H less than 8) using a quinhydrone electrode.

14. To determine the pH of various mixtures of sodium acetate and acetic acid in aqueous solution and hence determine the dissociation constant of the acid.

15. Titrate potentiometrically Zn (II) by $K_4Fe(CN)_6$ and verify the composition of the complex $K_2Zn_3\ [Fe(CN)_6]_2$

16. Determination of nitrite in water spectrophotometrically.

17. Determination of molecular weight of polymers by Tirbiditymetery.

18. Determine the molar refraction of a solid substance by dissolving it in a solvent and its refractive index.

Semester-IV

M.Sc. Chemistry (Semester-IV)
CH424: Inorganic Chemistry-IV
Advanced Inorganic Chemistry

60 hrs. **Time: 8 Hrs.**
Max. Marks: 60+15(Internal Assessment)

Instructions for paper setters and candidates

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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 diddipation by radiative and non-radiative processes, absorption spectra, franckcondon principle, photochemical stages- primary and secondary processes, kashia's rules, thexi states, photosubstitution reactions, adamson's rules, photo substitution reactions of Cr(III) and Rupolypyridyles. Rh(III) ammine complexes. Ligand photoreactions, photoredox reactions, comparision of Fe^{2+} and Ru^{2+} complexes. Photo reactions and solar energy conversion, photosynthesis in plants and bacteriocholophyll synthesis, photolysis of water using inorganic precursors.

UNIT-II

2.Oxidative addition and Insersion reactions **15Hrs**

Acid base behavior of metal atom in complexes, protonation and lewis base behavior, acceptor properties of lewis acidity of complexes, oxad and reductive elimination and their mechanism, addition of specific molecules, H_2 , HX and organic halide addition of some others 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, CO_2, SO_2, NO_2, 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.
Characterstics of hydride complexes, synthetic methods, chemical behavior of H^- complexes, mononuclear and homolepticpolyhydride anions, carbonyl H^- and anion H_2 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, $Ti(NO_3)_4$, $TiCl_4(diars)_2$, $[Ti(OEt)_4]_4$, $Zr(BH_4)_4$, $[M_6X_{12}]^+$ (M= Nb& Ta; X= halide); $VO(acac)_2$; $VOCl_2(NMe_3)_2$, $[Nb(n^5\text{-}C_5H_5)H\text{-}\square\ (n^5,n^1\text{-}C_5H_4)]_2$; Isopoly and heteropoly acids of MO, W & V; $[M_6X_8]^{4+}$ M= MO & W; $CrO(O_2)$ (bipy); $[MO_2O_4(C_2O_4)_2\ (H_2O)_2]^{2+}$; $[W_3O_2\ (O_2CMe)_6\ (H_2O)_3]^{2+}$;$[Cr_3O(O_2CMe)_6\ L_3]^+$;$[H_2W_2(CO)_9]^{2+}$; Re_3Cl_9;$[ReH_9]^{3+}$; $ReCl_6(Pet_3)_2$; $Re_2Cl_6(PEt_3)_2$; $Re_2Cl_5\ (DTH)_2$, Roussin's salts; $[Ir_3O(SiO_4)9]^{10-}$; $[Ir_3N(SiO4)_6(H2O)_3]^{4-}$;$[Co(acac)_2]_4$, α and β-MCl_2 (M=Pd,Pt);Wolffram's salt;$[Ni(acac)_2]_3$; $Ni(Me_6\text{-}acac)_2$; Ni (Me-sal)$_2$; $[Cren_3]$ $[Ni(CN)_5]$ 1.5 H_2O; $[Ni\ (CN)_2\ (NH_3)]$. xC_6H_6; $[Pd(O_2CMe)_2]_3$, $[pt(O_2CMe)_2]_4$; $[PtMe_3(acac)]_2$; helical chian of AuF_3, Silver (III) etylenedibiguanide ion; $[CuXL]_4$ X=halide, L = P or As Ligand; $[Au_3Cl_2(PMe_2Ph)_{10}]^{3+}$; $[Zn(acac)_2]_3$; $[Cd\{S=C(NHCH_3)_2\}_2(SCN)_2]$; $Hg(NH_3)_2Cl_2$

Books Recommended:

1.Chemistry of Elements by N. N. Greenwood and Earnshaw, Perganon Press
2. W. W. Portfield: Inorganic Chemistry: A Unified approach
3. Cotton and Wilkinson: Advanced inorganic Chemistry: V^{th} edition

M.Sc. Chemistry (Semester- IV)
CH425: Organic Chemistry-VI
Asymmetric synthesis, Green Chemistry and Heterocyclic Chemistry

60 Hrs. **Time: 8 Hrs.**
Max. Marks: 60+15(Internal Assessment)

Instructions for paper setters and candidates

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III. Section-I will consist of eight short questions carrying 1.5 Mark 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. Asymmetric Synthesis

(a) General Aspects **7Hrs**

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 **8Hrs**

Methods of asymmetric synthesis using chiral pool synthesis, auxilaries, chiral reagents and catalysts, Asymmetric carbon-carbon bond formation using alkylation, Michael reaction and additiontocarbonyl compounds.Cram's rule and Felkin-Ahn model.Asymmetric oxidationand reductions.

UNIT-II

2. **Enzymatic approach towards asymmetric synthesis** **8Hrs**

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 **7Hrs**

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

andelimination reactions, enolic intermediates in isomerization reactions, Enzyme catalyzedcarboxylation and decarboxylation.

UNIT-III

4. Co-Enzyme Chemistry 6Hrs

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 B_{12}. .

5. Green Chemistry approach towards synthesis 9Hrs

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 3Hrs

Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reaction.

(b) Small Ring Heterocycles 3Hrs

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

(c) Six-Membered Heterocycles with one Heteroatom 5Hrs

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, thiepines, 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 Textby Mike Lancaster, Royal Society of Chemistry, 2002
4. Principles of modern heterocyclic chemistry byLeo A. Paquette
5. Principles of Biochemistry By Voet and Voet
6.

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

60 hrs. **Time: 8 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. 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, polarones and bipolarons, fire resistant, liquids 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.