FACULTY OF SCIENCES

SYLLABUS

FOR

M.Sc. (Hons) Chemistry

(Semester I-II)
Session: 2019-2020

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-I			
Subject Code	**Subject**	**Max. Marks**	**Hrs**
Course-MHCH401	Inorganic Chemistry-I: (*Ligand Field and Group Theory)*	50	45
Course-MHCH402	Organic Synthesis-I (*C-C Bond Formation Reactions*)	50	45
Course-MHCH403	Physical Chemistry-I: *Thermodynamics*	50	45
Course-MHCH404	Spectroscopy A: *Techniques for StructureElucidation of Organic Compounds*	75	60
Course-MHCH405	Computer for Chemists – Theory	25	30
Course-MHCH406	Computer for Chemists – Practical	25	45
Course-MHCH407	Inorganic Chemistry Lab-I (*Quantitative Analysis*)	100	60
Course-MHCH408	Organic Chemistry Lab- I	100	60
TOTAL		**475**	**370**

Semester-II			
Subject Code	**Subject**	**Max. Marks**	**Hrs**
Course-MHCH409	Inorganic Chemistry-II: (*Metal-Carbon bonding and its applications*)	50	45
Course-MHCH410	Organic Synthesis-II (*Reaction Mechanism-Addition, Elimination and Rearrangements)*	50	45
Course-MHCH411	Physical Chemistry-II: *Quantum Chemistry*	50	45
Course-MHCH412	Spectroscopy B: *Techniques for Structure Elucidation of* Inor*ganic Compounds*	75	60
Course-MHCH413	Organic Synthesis-III(*Supramolecular, Reactive Intermediates and Disconnections)*	50	45
Course-MHCH414(a)	Mathematics for Chemists(Medical Students)	25	30
Course-MHCH414(b)	Biology for Chemists(Non Medical Students)		
Course-MHCH415	Physical Chemistry Lab-I	100	60
Course-MHCH416	Inorganic Chemistry Lab- II	100	60
TOTAL		**500**	**385**

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-I

M.Sc. (Hons) Chemistry (Semester-I)

MHCH401: Inorganic Chemistry-I

Ligand Field and Group Theory

45 Hrs. **Time: 4Hrs/week.**

Max. Marks: 37+13 (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 nine short questions carrying 1 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 7 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. Group theory and its applications-I **11 Hrs**

Symmetry, symmetry elements and operations, Determination of point groups(flow chart), Order and class of point group, Reducible and irreducible representations(H_2O and BF_3).

Multiplication tables and derivation of character tables for C_{2V},C_{3V} and cyclic group, Great orthogonality theorem, Mullikens notations.

UNIT-II

2. Group theory and its applications-II **11 Hrs**

Crystallographic Symmetry, Sub groups, determination of symmetry of atomic orbitals under different point groups.Hybridisation of atomic orbitals: sp,sp^2,sp^3,dsp^2,sp^3d and d^2sp^3 and group theory, Matric representation of symmetry operations, group theory and CFT.

Separation of d-orbitals under the influence of T_d,square planar, O_h and trigonalbipyramid symmetry, Vibrational modes in non-linear molecules, representation of vibrational modes in H_2O, NH_3 and BF_3. Group theory and linear molecules.

UNIT-III

3. Ligand Fields-I **11Hrs**

Concept and scope of ligand fields, d and other orbitals, Qualitative determination of ligand field effects, the physical properties affected by LF, Ionic model of coordination compounds, Spin-orbit coupling, free ion in weak CF, Effect of cubic field on S,P,D,F,G,H,I terms.

Heat of ligation and CFSE, Standard electrode potential and CFSE, Cation distribution in lattice, spinels, interionic separation and CFSE and chemical stability.

UNIT-IV

4. Ligand Fields-2 **12Hrs**

Free ion in medium and strong fields. Transition from weak to strong fields, Correlation and Tanabe Sugano diagrams for d^2 to d^9(O_h and T_d), Elementary MOT, Bonding in octahedral and tetrahedral complexes.

Qualitative calculations of 10 Dq. Electronic spectra of complexes, Selection rules and band widths and factors, Jahn Teller effect.Spectra of $[M(H_2O)_6]^{+2}$.

Spectra of spin free and paired complexes, distorted O_h and T_d complexes, Spectrochemical and Nephelauxetic series and CT spectra.

Books Recommended:

1) Chemical applications of Group theory by F.A. Cotton.
2) Introduction to Ligand fields by B.N. Figgis.
3) Group theory by Raman.
4) Group theory in Chemistry by Gopinathan and Ramakrishnan.

M.Sc. (Hons) Chemistry (Semester-I)

MHCH402: Organic Synthesis-I

(C-C Bond Formation Reactions)

45 Hrs. **Time: 4Hrs/week.**

Max. Marks: 37+13 (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 nine short questions carrying 1 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 7 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. Formation of carbon-carbon single bonds **11Hrs**

Alkylation: importance of enolate anions, Alkylation of relatively acidic methylene groups, γ-Alkylation of 1,3-dicarbonyl compounds; dianions in synthesis, Alkylation of ketones, The enamine and related reactions, Alkylation of α-thio and α-selenocarbanions, Umpolung (dipole inversion), The aldol reaction, Allylic alkylation of alkenes, The dihydro-1,3-oxazine synthesis of aldehydes and ketones, Coupling of organonickel and organocopper complexes, Reactions of lithium organocuprates: copper-catalysed reactions of Grignard reagents, Synthetic applications of carbenes and carbenoids, Formation of carbon-carbon bonds by addition of free-radicals to alkenes, Some photocyclisation reactions

UNIT-II

2. Formation of carbon-carbon double bonds **11 Hrs**

β-Elimination reactions, Pyrolytic*syn* eliminations, Sulphoxide-sulphenate rearrangement; synthesis of allyl alcohols, The Wittig and related reactions, Alkenes from sulphones, Decarboxylation of *β*-lactones, Stereoselective synthesis of tri- and tetra-substituted alkenes, Fragmentation reactions, Oxidative decarboxylation of carboxylic acids, Alkenes from arylsulphonylhydrazones, Stereospecific synthesis from 1,2-diols, Claisen rearrangement of allyl vinyl ethers, Reductive dimerisation of carbonyl compounds

UNIT-III

3. Reactions at unactivated C-H bonds **11Hrs**

The Hoffmann-Loeffler-Freytag reaction, Cyclisation reactions of nitrenes, The Barton reaction and related processes-photolysis of organic nitrites and hapohalites, photolysis of *N*-nitrosoamides, Reaction of monohydric alcohols and lead tetra-acetate, Miscellaneous reactions-unsaturated alcohols from hydroperoxides, cyclobutanols by photolysis of ketones, long-range functionalisation of unactivated carbons on the steroid nucleus.

UNIT-IV

4. Synthetic applications of organoboranes, organosilanes, organopalladium, organozinc, organocopper12Hrs

Hydroboration, Reactions of organoboranes-protonolysis, oxidation, enantioselective synthesis of secondary alcohols from alkenes, isomerisation and Cyclisation of alkylboranes, Formation of carbon-carbon bonds-carbonylation of organoboranes, reaction with α-bromoketones and α-bromoesters, reaction with diazo compounds, Reactions of alkenylboranes and trialkylalkynylborates, Free-radical reactions of organoboranes, Applications of organosilicon compounds in synthesis, Alkenylsilanes and allylsilanes, Control of rearrangement of carbonium ions, *α*-Silylcarbanions, *β*-Silylcarbonyl compounds, Trimethylsilyl cyanide, Trimethylsilyl iodide and triflate, Addition of Organo Zinc, Organo Copper, and Organolithium reagents to Carbonyl and unsaturated Carbonyl compounds.

Palladium-catalyzed cross-coupling reactions of Unactivated/activated alkyl electrophiles with organometallic compounds: Suzuki, Negishi, Stille, Sonogashira, Hiyama, Kumada-Murahashi, Buchwald-Hartwig coupling, Heck reaction and Tsuji-Trost reaction

Books recommended

1. Topics in Organometallic Chemistry: 'Palladium in Organic Synthesis' (Editor: Jiro Tsuji)

   Volume 14, **2005**

2. Advanced Organic Chemistry, 4th Edition, Part B: Reactions and Synthesis by Francis A. Carey and Richard J. Sundberg, Plenum Press, N.York, **2001**, 4th edition.

3. *Modern Methods of Organic Synthesis*, 4thEdition by W. Carruthers and L. Coldham,Cambridge University Press, **1971**, 2nd edition.

4. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford)

M.Sc. (Hons) Chemistry (Semester-I)

MHCH403: Physical Chemistry

Thermodynamics

45 Hrs. **Time: 4Hrs/week.**

Max. Marks: 37+13 (Internal Assessment)

Instructions for paper setters and candidates

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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 nine short questions carrying 1 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 7 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.Classical Thermodynamics-I **11Hrs**

Brief resume of concepts of thermodynamics, Helmholtz and Gibb's free energy, chemical potential and entropy.Partial molar properties, partial molar free energy, partial molar volume and partial molar heat content and their significances.Determination of these quantities.Concept of fugacity and determination of fugacity.

UNIT-II

2.Classical Thermodynamics-II **11 Hrs**

Non-ideal systems: Excess functions for non-ideal solutions. Activity, activity coefficients, Debye-Huckel theory for activity coefficient of electrolytic solutions, determination of activity and activity coefficients, ionic strength.

UNIT-III

3. Statistical Thermodynamics: **13Hrs**

Thermodynamic probability, Most probable distribution, Stirling approximation, Maxwell-Boltzmann distribution law, Entropy and probability, Ensemble averaging, postulates of ensemble averaging. Types of ensemble systems, Lagrange's method of undetermined multipliers.

Partition functions: Translational, rotational, vibrational and electronic partition function, calculation of thermodynamic properties in terms of partition functions. Application of partition functions in the determination of equilibrium constants and heat capacity behavior of solids-chemical equilibria.

Types of statistics: Fermi-Dirac statistics-distribution laws, Bose-Einstein statistics- distribution law and application to helium.

UNIT-IV

4. Non Equilibrium Thermodynamics: 10 Hrs

Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes: heat flow, chemical reactions. transformations of generalized fluxes and forces, non-equilibrium stationary states, phenomenological equations, microscopic reversibility, irreversible thermodynamics for biological systems, coupled reactions.

Books recommended:

1. S. Glasstone: Thermodynamics for Chemists
2. P.W. Atkins: Physical Chemistry
3. S.H. Maron& C.F. Prutton: Principles of Physical Chemistry
4. Introduction to the Thermodynamics of Biological Processes by D. Jou& J. E. LLebot.
5. Pitts: Non equilibrium thermodynamics
6. I Prigogine: Introduction to thermodynamics of irreversible processes

M.Sc. (Hons) Chemistry (Semester-I)

MHCH404: Spectroscopy-A

Techniques for Structure Elucidation of Organic Compounds

60 hrs. **Time: 6Hrs/week.**

Max. Marks: 56+19 (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 EIGHT 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 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. General Features of Spectroscopy: 3 Hrs

Units and conversion factors.Introduction to spectroscopy, Nature of radiation. Energies corresponding to various kinds of radiation, Experimental techniques, intensities of spectral lines, Selection rules and transition moments, Line widths, Broadening.

2. Nuclear Magnetic Resonance Spectroscopy-I 12Hrs

PMR: Natural abundance of ^{13}C, ^{19}F and ^{31}P nuclei; The spinning nucleus, effect of external magnetic field, precessional motion and frequency, Energy transitions, Chemical shift and its measurements. Factors influencing chemical shift, anisotropic effect; Integrals of protons, proton exchange, spin-spin coupling- splitting theory, one, two and three bond coupling, virtual, long range and allylic coupling, magnitude of coupling constant; factors affecting the coupling constant, Chemical and magnetic equivalence, First and second order spectra, A_2, AB, AX, AB_2, AX_2, A_2B_2 and A_2X_2 spin systems.

UNIT-II

3. Nuclear Magnetic Resonance Spectroscopy-2 13 Hrs

Simplification of complex spectra (solvent effect, field effect, double resonance and lanthanide shift reagents), CW and FT NMR, Relaxation processes, T1 and T2 measurements, Applications of PMR in structural elucidation of simple and complex compounds.^{13}C-NMR: Resolution and multiplicity of ^{13}C NMR, ^{1}H-decoupling, noise decoupling, broad band decoupling; Deuterium, fluorine and phosphorus coupling; NOE and origin of nuclear overhauser effect. off-resonance, proton decoupling.

Structural applications of ^{13}C-NMR., pulse sequences, pulse widths, spins and magnetization vectors, DEPT, INEPT.

Introduction to 2D-NMR, COSY, NOESY, HSQC spectra

UNIT-III

3. Mass Spectra: 8 Hrs Introduction, methods of ionization EI & CI, Brief description of LD, FAB, SIMS, FD etc., Ion

analysis methods (in brief), isotope abundance, Metastable ions, general rules predicting the fragmentation patterns. Nitrogen rule, determination of molecular ion peak, index of H deficiency, fragmentation patterns for aliphatic compounds, amines, aldehydes, Ketons, esters, amides, nitriles, carboxylic acids ethers, aromatic compounds etc.

4. UV and Visible Spectroscopy of organic molecules: 8 Hrs

Measurement techniques, Beer – Lambert's Law, molar extinction coefficient, oscillator strength and intensity of the electronic transition, Frank Condon Principle, Ground and first excited electronic states of diatomic molecules, relationship of potential energy curves to electronic spectra, Chromophores, auxochromes, blue shift, red shift, hypo and hyperchromic effect, n-σ*,π-π*, n-π* transitions in organic molecules.

Woodward rules for conjugated dienesand , - unsaturated carbonyl groups, extended conjugation and aromatic sterically hindered systems, Quantitative applications.

UNIT-IV

5. Infrared Spectroscopy 8 Hrs

Vibrational Energy Levels, Selection Rules, Force Constant, Fundamental Vibration requencies, Factors influencing Vibrational Frequencies (Vibrational Coupling, Hydrogen Bonding, lectronic effect, Bond Angles, Field Effect). Sampling Techniques, Absorption of Common functional Groups, Interpretation, Finger print Regions.

Applications in Organic Chemistry

(a) Determining purity and quantitative analysis.
(b) Studying reaction kinetics.
(c) Determining purity and quantitative analysis.
(d) Studying hydrogen bonding.
(e) Studying molecular geometry & conformational analysis.
(f) Studying reactive species

6. Solution of Structural Problems by Combined Use of the following Spectroscopic Techniques 8Hrs

(a) Electronic spectra
(b) Vibrational spectroscopy
(c) NMR (1H and 13C) spectroscopy
(d) Mass Spectroscopy

Books Recommended:

1. Pavia, Lampman&Kriz, Introduction to Spectroscopy.
2. C.N Banwell "Fundamentals of Molecular Spectroscopy".
3. R. M. Silverstein, G.C.Bassler, T.C. Morrill, "Spectrometic Identification of Organic Compounds.
4. W. Kemp, "Organic Spectroscopy".
5. D.H. Williams, I. Fleming, "Spectroscopic Methods in Organic Chemistry".
6. D.H. Williams, I. Fleming, "Spectroscopic Problems in Organic Chemistry", 1967.
7. R.C. Banks, E.R. Matjeka, G. Mercer, "Introductory Problems in Spectroscopy", 1980.
8. G.M. Barrow "Introduction to Molecular Spectroscopy".

M.Sc. (Hons) Chemistry (Semester-I)

MHCH405: Computer for Chemists

(Theory 30Hrs + Practical 30Hrs) **Max. Marks: 25**
Theory Marks: 18+7(Internal Assessment)

The paper will consist of 30 Hours of teaching in class room and 15 sessions of 2 hours of practical training on computers. The theory will be of 25 marks and practical would be of 25 marks. The students would prepare a record of the programs written by them along with the outputs.

Instructions for paper setters and candidates

The question paper should consist of three sections.

Section-A

It will consist of six short questions of 0.5 marks each, all questions in this section will be compulsory. The total weightage of this section will be 3 marks

Section-B

It will consist of ten questions of 1.5 marks each, Six questions are to be attempted. The total weightage of this section will be 9 marks

Section-C

It will consist of four questions of 3 marks each, Two questions are to be attempted. The total weightage of this section will be 6 marks

1. Computer Programming in C language

Principles of programming, algorithms and flowcharts.Elementary programming, a typical C program, printf function. Introduction of declarations, assignments and variables: concept of an integer, concept of a variable, rules for naming variables, assignment statement, arithmetic operators. Integer arithmetic expressions, truncation effects, relative priority of arithmetic operators, use of parenthesis, modulus operator. Floating point numbers, scientific notation, converting integers to floating point and vice versa , coercion and cast operator, type char.

Decision making in C, scan f function, relational operators, logical operators, if statement, if else statement, nesting of if statement.

The while loop, do while loop, for loop, nesting of for loop.

Type char and ASCII code, character strings and how to print them, octal and hexadecimal notation.

User defined functions, returning value from a function, functions with more than one parameters.

Arrays, declaring an array, initializing an array, break statement, strings and character arrays, sorting an array, finding maximum and minimum in an array, multidimensional arrays.Input and output.

M.Sc. (Hons) Chemistry (Semester-I)

MHCH 406: Computer for Chemists Lab

Max. Marks: 25
Practical Marks: 18+7(Internal Assessment)

1. Practicals based upon MS Word, MS Excel and Power point

2. Computer programs in Chemistry

1. Calculation of mean, median, mode.
2. Solution of a quardratic equation.
3. Calculation of linear regression.
4. Calculation of curve linear regression.
5. Calculation of Bohr orbit from de Broglie Lambda for electron.
6. Calculation of wave number and frequency from value of wave length.
7. Calculation of van der Waals radii.
8. Radioactive decay.
9. Rate constant of a 1st order reaction, 2nd order reaction.
10. Determination
11. Calculation of lattice energy using Born Lande equation.
12. Addition, multiplication and solution of inverse of 3 X 3 matrix.
13. Calculation of average molecular weight of a polymer containing n1 molecules of molecular weight m1, n2 molecules of molecular weight M2 and so on.
14. Program for calculation of molecular weight of organic compound containing C, H, N, O and S.
15. Calculation of reduced mass of diatomic molecule.
16. Calculate the RMS and most probable velocity of a gas.
17. Calculate the ionic mobility from ionic conductance values.
18. Determine the thermodynamic parameters for isothermal expansion of monoatomic ideal gas.
19. Calculation of value of g- factor from value of J and S.
20. Calculate the bond length and bond angles using crystal structure data.

Recommended Books:

1. K.V. Raman, Computers in Chemistry, Tata McGraw Hill.
2. Mullish Cooper, The spirit of c, An Introduction to Modern Programming.

M.Sc. (Hons) Chemistry (Semester-I)

MHCH407: Inorganic Chemistry Practical-I

Quantitative analysis

Max. Marks: 75+25 (Internal Assessment) **Labs Hrs.: 60**

I. Oxidation-Reduction Titrations

1. Standardization with sodium oxalate of $KMnO_4$ and determination of Ca^{2+} ion.
2. Standardization of ceric sulphate with Mohr's salt and determination of Cu^{2+}, NO_3^{-1} and $C_2O_4^{-2}$ ions.
3. Standardization of $K_2Cr_2O_7$ with Fe^{2+} and determination of Fe^{3+} (Ferric alum)
4. Standardization of hypo solution with potassium iodate / $K_2Cr_2O_7$ and determination of available Cl_2 in bleaching powder, Sb^{3+} and Cu^{2+}.
5. Determination of hydrazine with KIO_3 titration.

II. Precipitation Titrations

1. $AgNO_3$ standardization by Mohr's method by using adsorption indicator.
2. Volhard's method for Cl^- determination.
3. Determination of ammonium / potassium thiocyanate.

III. Complexometric Titrations

1. Determination of Cu^{2+} and Ni^{2+} by using masking reagent by EDTA titration.
2. Determination of Ni^{2+} (back titration).
3. Determination of Ca^{2+} (by substitution method).

IV. Gravimetric Analysis

1. Determination of Ba^{2+} as its chromate.
2. Estimation of lead as its lead molybdate.
3. Estimation of chromium (III) as its lead chromate.
4. Estimation of Cu^{2+} using Ammonium/ Sodium thiocyanate.

Book: Vogel's book on Inorganic Quantitative Analysis.

M.Sc. Chemistry (Semester-I)

MHCH408: Organic Chemistry Lab-I

Quantitative analysis and Multistep Synthesis

Max. Marks: 75+25 (Internal Assessment) **Labs Hrs.: 60**

1. Quantitative Analysis

(a) Extraction of Organic Compounds from Natural Sources

1.Extraction of Caffeine from tea leaves
2. Isolation of casein from milk (try some typical colour reactions proteins).
3**.** Isolation of essential oils from Caraway seeds and orange peels – (S) – Carvone and (R) – Limonene

(b) Quantitative Analysis of Organic Compounds:

1. Estimation of phenol/aniline using bromate-bromide solution.
2. Estimation of reducing sugar by Fehling solution method.
3. To determine the saponification value of the given fat or oil sample.
4. To determine the iodine number of the given fat or oil sample.

2. Multistep Organic Synthesis

1. Synthesis of 2-chloro-4-bromoaniline from aniline (Bromination and chlorination)
3. Photochemical synthesis of benzpinacol and its pinacol rearrangement.
4. Synthesis of o-chlorobenzoic acid from phthalimide. Synthesis of acridone from o-chlorobenzoic acid. (Hofmann bromamide and Sandmeyer's reaction).
4. Synthesis of 2,4-dinitrophenyl hydrazine from chloro benzene. (Electrophilic and nucleophilic substitution reactions on aromatic ring).
5.Synthesis of 2-phenyllndole-Fischer Indole Synthesis. Synthesis of 3-nitrobenzoic from benzoic acid
6.Cannizaro's reaction of 4-chlorobenzaldehyde..

Book Recommended:

1.Vogel's Textbook of Practical Organic Chemistry

Semester-II

M.Sc. (Hons) Chemistry (Semester-II)

MHCH409: Inorganic Chemistry-II

Metal-Carbon bonding and its applications

45 Hrs. **Time: 4Hrs/week.**

Max. Marks: 37+13 (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 nine short questions carrying 1 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 7 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

Introduction, The 18 Valence Electron Rule: Introduction, The 18 electron rule, counting of electrons and finding metal-metal bonds and related problems. Recaptulation of Metal carbonyls. Alkyl, Aryl and Ligands with Higher Hapticity: (i) Sigma bonded alkyl groups as ligands: Synthesis of metal-alkyl compounds, β-hydride elimination, σ-bonded η1 -aryl ligands. (ii) Cyclic and acyclic polyenyl π-bonded ligands: Cyclopentdienyl (Cp-), Synthesis of Cp based sandwich compounds, Structure and properties of MCp2 complexes, The first metal- sandwich compound Ferrocene, Reactions of metal-sandwich compounds, Bent sandwich compounds, Schwartz reagent and hydrozirconation, Chemistry of Cp* , Chemistry of arene sandwich compounds, Allyl groups as ligands, 1,3-Butadiene complexes, Cyclobutadiene complexes, Cycloheptatriene and Cyclooctatetraene as ligands. Davies-Green-Mingos (DGM) rules.

UNIT II

Ferrocene: Structure and bonding of ferrocenes, Basic chemical reactions of Ferrocene, Reactions of Acetyl Ferrocene and formylFerrocene, lithiatedferrocenes and their reactions, (Dimethylaminomethyl)Ferrocene and its methiodide salt, Ferroceneboronic acid and haloferrocenes, Chirality in Ferrocene derivatives, Synthesis of chiral Ferrocene based compounds, Ferrocene based condensation polymers

UNIT-III

Catalytic reactions and 16/18 electron rule, alkene metathesis, Chauvin mechanism, Olefin polymerization, Ziggler-Natta polymerization, Cossee mechanism, hydrogenation of alkenes Wilkinson's catalyst, Fischer-Tropsch reactions, water gas shift reactions, Monsanto acetic acid process, hydrocyantion, Reppecarbonylation, hydroformylation of unsaturated compounds. Reductive carbonylation of alcohols and other compounds, carbonylation reactions: methanol and methyl acetate, adipic ester and other compounds,

UNIT IV

synthesis and carbonylation reactions, decarbonylation reaction, catalytic addition of molecules to carbon-carbonmultiple bonds, homogeneous hydrogenation, hydro cyanation and hydro silation of unsaturated compounds,polymerization. Oligomerisation and metathesis of alkene and alkynes. Cluster compounds in catalysis,supported homogeneous and phase transfer catalysis, oxidation reactions, oxidative carbonylation. Pdcatalysed oxidation of ethylene,acrylo nitrile synthesis,oxygen transfer from peroxo and oxo species and NO_2 groups

Recommended Books:

1. J.E. Huheey, Inorganic Chemistry Principles of Structure and Reactivity, Harper Inter-Science.
2. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, Wiley Inter-Science.
3. B.D. Gupta and A.J. Elias, Basic Organomettallic Chemistry, Universities Press.
4. C.E.A. Salzer and E. Elchinbroich, Organometallics, A Concise Introduction Chemistry, VCH.

M.Sc. (Hons) Chemistry (Semester-II)

MHCH410: Organic Synthesis-II

Reaction Mechanism- Addition, Elimination and Rearrangement Reactions

45 Hrs. **Time: 4Hrs/week.**
Max. Marks: 37+13 (Internal Assessment)

Instructions for paper setters and candidates

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UNIT-I

1. Addition to Carbon-carbon and Carbon-Hetero Multiple Bonds-I 12Hrs

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Addition to cyclopropanering.Hydrogenation of double and triple bonds, hydrogenation of aromatic rings.Hydroboration.Michaelreaction.Sharpless asymmetric epoxidation. Addition of Grignard reagents, organozinc, organolithium and Gillman reagents to carbonyl and unsaturated carbonyl compounds. Use of other organometallic reagents in addition reactions. Wittig reaction,

UNIT-II

2. Addition to Carbon-carbon and Carbon-Hetero Multiple Bonds-II 3Hrs

Mechanism of condensation reactions involving enolates – Aldol,.Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.
Hydrolysis of esters and amides, ammonolysis of esters.

3. Rearrangements and Coupling Reactions 8 Hrs

General mechanistic consideration – nature of migration, migratory aptitude, memoryeffects. A detailed study of the following rearrangements, Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil-Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber,Beckmann, Hofman, Curtius, Schmidt, Shapiro reaction, Fries rearrangement.Reaction and mechanism of Diazo coupling, Glaser coupling, Heck reaction, Mcmurry reaction, Stille coupling, Suzuki coupling, Sonogashira reaction.Negishiand Hiyama coupling.

UNIT-III

4. Elimination Reactions: 5 Hrs

The E_2, E_1 and E_1cB mechanisms and their spectrum.Orientation of the double bond. Reactivity – effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.

5. Oxidation Reactions: 7 Hrs

Indtoduction.Different oxidative processes. Hydrocarbons- alkenes, aromatic rings, saturated C-H groups)activated and unactivated). Alcohols, diols, aldehydes, ketones, ketals and carboxyalicacids.Amines, hydrazines, and sulphides. Oxidations with ruthenium tetraoxide, iodobenzenediacetate and thallium (III) nitrate, DDQ, PCC, CAN, selenium dioxide, peroxyacids, DCC. Oxidation reactions with special emphasis on Baeyer-villeger reaction, Cannizarro oxidation-reduction reaction,

UNIT-IV

6. Reduction Reactions: 10 Hrs

Introduction. Different reductive processes, Hydrocarbons- alkanes, alkenes, alkynes and aromatic rings, Carbonyl compounds – aldehydes, ketones, acids, ester and nitriles. Epoxides, Nitro, nitroso, azo and oxime groups, Hydrogenolysis. Sodium borohydride, sodium cyanoborohydride, LAH, disobutylaluminium hydride, tin hydride, trialkyl tin hydride, trialkylsilanes, alkoxy substituted LAH, DIBAL, diborane, diisoamylborane, hexyl borane, 9-BBN, isopinocamphenyl and disiopinocamphenylborane. Reduction reactions with particular emphasis on Wolf-Kishner reduction, Clemensen reduction.

Recommended Books:

1. Organic Reaction Mechanism by Jerry March, John Wiley Ed. 5, 2002.
2. Advanced Organic Chemistry by Francis Carey, Vol A and vol B

-M.Sc. (Hons) Chemistry (Semester-II)

MHCH411: Physical Chemistry-II

Quantum Chemistry

45 Hrs. **Time: 4Hrs/week.**

Max. Marks: 37+13 (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 nine short questions carrying 1 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 7 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. Quantum Theory: Introduction and Principles **12Hrs**

Black body radiations, planck's radiation law, photoelectric effect, Compton effect, De- Broglie hypothesis, the Heisenberg's uncertainty principle, Rydberg relation for explaining atomic spectrum of hydrogen. Bohr's Theory and its limitation solution of classical wave equation by separation of variables method.

UNIT-II

2. Quantum mechanical operators **5 Hrs**

Operators and observations, normal and orthogonal functions, hermitian and unitary operators, introduction to differentiation and integration, Eigen value equation. Hamiltonian operator, interpretation of wave function, postulates of quantum mechanics.

3. Applications of Quantum Postulates **7Hrs**

Solution of particle in one and three dimensional box, degeneracy, the linear harmonic oscillator, rigid rotators, quantization of vibrational and rotational energy levels, hydrogen atom.

UNIT-III

3. Angular Momentum **5 Hrs**

Commutative laws, need of polar coordinates, transformation of Cartesian coordinate into polar coordinate, angular momentum of one particle system, orbital angular momentum, the ladder operator for angular momentum, spin angular momentum and their relations.

4. The Approximate Methods **6 Hrs**

Need for approximation methods, Perturbation and Variation methods and their application to Helium atom.

UNIT-IV

4. General Orbital Theory of Conjugated Systems **10Hrs**

Chemical bonding, linear combination of atomic orbital, overlap integral, coulomb's integral, bond order, charge density calculations for ethylene, allyl system, butadiene system, cyclo butadiene cyclopropenyl system.

Recommended Books:

1. Physical Chemistry, A Molecular Approach by MacQuarrie and Simon.
2. Quantum Chemistry, Ira N. Levine, Prentice Hall.
3. Quantum Chemistry, H. Eyring, Kimball and Walter.
4. Quantum Chemistry, Atkin.
5. Fundamentals of Quantum Chemistry, Anantharaman. R.

M.Sc. (Hons) Chemistry (Semester-II)

MHCH412: Spectroscopy-B

Techniques for Structure Elucidation of Inorganic Compounds

60 hrs. **Time: 6Hrs**

Max. Marks: 56+19 (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 EIGHT 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 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. Vibrational Spectroscopy **15 hrs**

Theory of Infrared Absorption: Harmonic and anhormonic oscillators, absorptions of radiation by molecular vibrations, selection rules, force constant, frequency of vibrational transitions of HCl, vibrations in a polyatomic molecule, 3N-6 and 3N-5 rules, types of vibrations, overtones, combination and difference bands, examples of CO_2, SO_2, and H_2O, Fermi resonance, group vibrations.

Raman Spectroscopy: Introduction, selection rules, anisotropic polarizability, Stokes, anti-Stockes lines, vibrational Raman spectra of CO_2 and H_2O, polarised and depolarised Raman lines, rule of mutual exclusion, vibronic coupling.

Determination of I.R/Raman Active Modes: Significance of nomenclature: used to describe various vibrations, use of symmetry considerations to determining the number of active infrared and Raman lines (character tables to be provided in the Examination).

Sample handling. Factors affecting absorption frequencies.Interpretation and finger printing regions. Applications of Raman and I.R selection rules to the determination of Inorganic structure with special emphasis on:

i) Metal carbonyls
ii) NSF_3
iii) Geometrical isomerism – differentiation between Cis and trans $[Co(bipy)_2Cl_2]Cl$.
iv) Structures of CO_2, N_2O, H_2O, chlorocomplexes of mercury, cadmium and zinc, and octahedral complexes SiF_6^{2-}, PF_6^-, SF_6.
v) Changes in the spectra of donor molecules upon coordination with special emphasis on N, N-dimethylacetamide and DMSO with Fe^{3+}, Cr^{3+}, Zn^{2+}, Pd^{2+} and Pt^{2+} ions. I.R spectroscopy and modes of coordination of SO_4^{2-}, N_2, O_2, NO, CO_3^{2-}, NO_3^-.

UNIT-II

2. **Pure Rotational Spectra** **8 hrs**Classification of molecules according to their moment of inertia.Rotational spectra of diatomic

molecules (rigid rotator), Intensities of spectral lines, isotopic substitution effects, non-rigid rotator, polyatomic linear and symmetric top molecules, Stark effect.

3. Nuclear Quadruple Resonance Spectroscopy 7 hrs

Introduction, Experimental considerations, fundamentals of NQR spectroscopy, origin of EFG, measurement of energy differences between two nuclear spin states, the asymmetry parameters, effects of magnetic field, crystal field. Interpretation of spectra, application of the technique to halogen compounds (Organic), group elements, transition metals. Double resonance technique.

UNIT-III

4. Photo Electron Spectroscopy 8 hrs

Introduction, excitation and ejection of electrons, electronic energy in atoms and molecules, core level PES, symmetry and molecular orbitals, molecular orbital diagrams of dinitrogen and dioxygen, their XPS spectra, Valence electron photoelectron spectroscopy, Franck Condon principle, dissociation, predissociation, change of shapes of molecules on excitation.

5. Mössbauer Spectroscopy 8hrs

Principle, experimental considerations, conditions of MB Spectra, the spectrum and its parameters, simple spin states (I ½, 3/2), higher spin states (I > 3/2), magnetic splitting significance of parameters obtained from spectra, quadruple splitting, additive model, interpretation of MB Spectra of ^{57}Fe, ^{119}Sn. Application to biological systems, surface study, and compounds of group elements.

UNIT-IV

6. Electron Spin Resonance Spectroscopy 14hrs

Introduction, principle, brief instrumentation of spectrum, hyperfine splitting in isotropic systems involving more than one nucleus, ESR spectrum of benzene radical anion, methyl radical, CH_2OH, H_3CCH_2 radical, cyclopentadienyl, cycloheptatrienyl radical, pyrazine anion, pyrazine anion with ^{23}Na and ^{39}K counter ion and p-benzosemiquinone, DPPH, Naphthalene. Factors affecting magnitude of g values, zero field splitting, and Krammer's degeneracy. Qualitative survey of EPR spectra of first row transition metal ion complexes (d^1, d^2, d^3, low spin d^5, high spin d^6, d^7, d^9 system). Spectra of triplet states, rate of electron exchange, double resonance (ENDOR, ELDOR)

Books Recommended:

1) R. S. Drago, "Physical Methods in Chemistry". W.B Saunders Company.
2) C. N. Banwell, "Fundamentals of Molecular Spectroscopy".
3) R. V. Parish, "NMR, NQR, EPR & Mossbauer spectroscopy in Inorganic Chemistry". Ellis Horwood, London, 1990.
4) G. M. Barrow, "Introduction to Molecular Spectroscopy".
5) E. A. Ebsworth, S. Craddock and D. W. H. Rankin, "Structural methods in Inorganic Chemistry".Blackwell Scientific Publications (1991).
6) C. N. R. Rao and J. R. Ferraro, "Spectroscopy in Organic Chemistry, Vol. I". Academic Press (1971)
7) Walker and Straughan, "Spectroscopy, Vol I and III".

M.Sc. (Hons) Chemistry (Semester-II)

MHCH413: Organic Synthesis-III

Supramolecular, Reactive Intermediates and Disconnections

45 Hrs. **Time: 4Hrs/week.**

Max. Marks: 37+13 (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 nine short questions carrying 1 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 7 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. Supramolecular Chemistry-I

(a) Concepts **3Hrs**

Definition and Development of Supramolecular Chemistry, classification of Supramolecular Host-Guest compounds, Pre- organization and Complementarily, Receptors, Nature of Supramolecular interactions.

(b)Binding of anions and neutral molecules **8Hrs**

Biological anion receptors, concepts on anion host design, Fromcation to anion hosts-a simple change in pH, Guanidinium- based receptors, Neutral receptors, organometallic receptors, coordination interactions. Inorganic solid state clathrate compounds, solid state clathrates of organic hosts, intracavity complexes of neutral molecules, supramolecular chemistry of fullerenes.

UNIT-II

2. Supramolecular Chemistry-II

(c) Cation Binding Host **5Hrs**

Crown ethers, Lariat ether and Podands, Cryptands, spherands, selectivity, Macro cyclic, Macrobicyclic and Template effects, soft ligands, calixarenes, carbon donor and - acid ligands, siderophores.

(d) Crystal Engineering and Molecular Devices **6Hrs**

Concepts, crystal structure prediction, Crystal Engineering with hydrogen bonds, weak hydrogen bonds, hydrogen bonds to metals and metal hydrides, π- πstacking, coordination polymers. Introduction, Supramolecular photochemistry, molecular electronic devices: Switches, wires and rectifiers, machines based on catenanes and rotaxanes.

UNIT-III

3. Organic Reactive Intermediates-I 12Hrs

(a)Carbanions: Chemistry of enolates and enamines, kinetic and thermodynamic enolates, Lithium and boron enolates in aldol and Michael reactions, alkylation and acylation of enolates, Nucleophilic additions to carbonyls and streroechemical aspects through various models (crams / cram chelation / Felkin-Anh models)

(b)Carbocations: Structure and stability of carbocations, classical and non classicalcarbocations, Neighbouring group participation.

(c)Carbenes and Nitrenes: Structute, generation addition and insertion and rearrangement reactions of carbenes such as wolf rearrangement. Generation of ylids by wolf decomposition.Structure, generation and reactions of nitrene and related electron deficient nitrogen intermediates.

UNIT-IV

4. Organic Reactive Intermediates 06Hrs

(d)Ylids: Chemistry of Phosphorous and Sulphurylids-Wittig and related reactions, Peterson olefination etc.

(e)Radicals: Generation of radical intermediates and its addition to alkenes, alkynes for C-C bond formation and Baldwins rule. Fragmanetation and rearrangements reactions like decarboxylation, McMurry coupling etc.

5. Disconnection approach 05Hrs

An introduction to synthons and synthetic equivalents, disconnection approach, functional group interconversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reactions, amine synthesis.

Recommended Books :

1. J.W Steed and J.L Atwood, Supramolecular chemistry, John Wiley & Sons, Ltd. New York.
2. Designing Organic Synthesis, S. Warren, Wiley
3. Organic Synthesis- Concepts, Methods and Starting Materials, J. Fuhrhop and G. Penzillin, Verlag VCH.
4. Advanced Organic Synthesis Part A and B, F.A. Carey and R. J. Sundberg, Plenum Press.
5. Principles of Organic Synthesis, R. Norman and J. M. Coxon, Blackie Acdemic& Professional
6. *Modern Methods of Organic Synthesis* Cambridge University Press (1971). Carruthers,
7. Reactive Intermediates, Gilchrist and Rees

M.Sc. (Hons) Chemistry (Semester-II)

MHCH414(a): Mathematics for Chemists

For Non-Medical Students

30 hrs. **Time:2HrsMax.**
Marks: 18+07(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 ½ 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 3½ 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. Trignometry **7 Hrs**

Definition of sin, cos, tan, cot, sec, cosec functions with the help of unit circle, values of sin x cos x cos x for x = 0, n/6, n/3, n/2. Meaning of a trignometrical identity. The following identities (no need of derivation and proof. However, application has to be
emphasized).
$Cos^2x+sin^2x = 1$
Sin (x=2π)-Sin^2x/½ sin x
Cos (x-2π)Cos x
Cos(-x = cos x; sin(-x) = sin x
Sin(π-x) = sin x ; cos (π-x) = -cos x
Sin(π+x)= -xin x; (π+x) = -co x
Sin 2x = 2 sin x cos x
Cos 2x = 2 sin x cos x
Cos 2x = 2lcosx^{-1}
Tan (x) = -sin x; cos x
Tan (x) = -tan x; tan(x/2 – x = cot x)
Tan (π-x) = -tan x
Tan 2x = 2 tan x/(1-tan^2x)

UNIT-II

2. Determinants and Matrices **5 Hrs**

Definition and expansion properties of determinants, product of two determinants of 3rd order.
Introduction to various terms Matrix, row, column, diagonal unit. Sub, square, equal matrices, null, symmetricular, order of, character of, transpose of, adjoint of, inverse of matrices. Addition

multiplication, diagonalization, similarity transformation of matrices, characteristic equation statement of CayleyHumilton theorem. Rank of matrix, condition of consistency of a system of linear equations. Eigen vectores and Eigen values using matrices.

UNIT-III

3. **Differential Calculus** **8 Hrs**

Differentiation of standard functions, theorems relating to the derivative of the sum, difference, product and quotient of functions, derivative of trigonometric functions, inverse trigonometric functions, logarithmic functions and exponential functions, differentiation of implict functions, logarithmic differentiation.

UNIT-IV

4. **Integral Calculus (10 Hrs.)**

Integration as an inverse of differentiation summation, area under a curve, indefinite integrals of standard forms, method of substitution, method of partial fractions, integration by parts, definite integrals, reduction formulae, definite integrals of limit of a sum and geometrical interpretation.

Books Recommended:

1. Santi Narayan – Differential Calculus.
2. Santi Narayan - Integral Calculus.
3. B.S. Grewal – Higher Engineering Mathematics.
4. Joseph B. Dence – Mathematical Techniques in Chemistry.
5. Margenau and Murphy, the Mathematics of Physics and Chemistry.
6. B.L. Moncha and H.R. Choudhary – A Text Book of Engineering Mathematics.

M.Sc. (Hons) Chemistry (Semester-II)
MHCH414(b): Biology for Chemists

For Medical Students

30 hrs. **Time: 2 Hrs**

Max. Marks: 18+07 (Internal Assessment)

Instructions for paper setters and candidates

I. Examiner will set total of TEN questions.
II. Section-A will be of the First Question consisting of six short answer type questions of ½ mark each coveringthewhole syllabi. This will be a compulsory question. The total weightage will be 3 Marks.
III. Section B, C and D will consist of 3 questions from each Unit-I, II and III respectively. Each question will be carrying 3 marks and the students are required to attempt Five questions in all, at leastONE question from eachunit.The weightage of this section will be 15 Marks

UNIT-I

1. The Organisation of Life **10Hrs**

Biologically important molecules: Carbohydrates, lipids, proteins and nucleic acids.
The life of cells – The cell theory, general characteristics of cells, difference between proaiyotic and eukaryotic cells, difference between plant and animal cells, cell organells.
Tissues, organs and organ systems: Animal tissues; epithelial tissues, connective tissues, muscle tissue, nervous tissue and neoplasias; plant tissue: maristematic tissue, permanent tissues.

UNIT-II

2. Genetics **10Hrs**

The basic principle of heredity: Mendals law, monohybrid cross, dihybrid cross.
DNA – Double halix structure and replication.
Genes expression: Transcription and translation, genetic code.

UNIT-III

3. The Diversity of Life **10Hrs**

The classification of Living things – Criteria of classification, Whittaker's systems of classification, their characteristics with are example of each.
Viruses, structure of Viruses.

Book Recommended:

1. Cord Biology - South Western Educational Publications, Texas, 2000.

M.Sc. (Hons) Chemistry (Semester-II)

MHCH415: Physical Chemistry Practical-I

Max. Marks: 75+25(Internal Assessment) **Labs Hrs.: 60**

1. To determine the strength of given acid by *p*H metrically.
2. To determine dissociation constant of given acid *p*H metrically
3. Titration of weak acid conductometrically
4. Titration of strong acid conductometrically
5. To determine dissociation constant of given acid conductometrically
6. Determine the dissociation constant of acetic acid in DMSO, DMF, dioxane by titrating it withKOH.
7. Determine the activity coefficient of an electrolyte at different molalities by e.m.f. measurements.
8. Compare the cleansing powers of samples of two detergents from surface tension measurements.
9. Determine the specific refraction, molar refraction and atomic parachor with the help of Abbe'srefractometer.
10. To study the distribution of benzoic acid between benzene and water.
11. Determine the equilibrium constant of reaction K_1+ +l_2→ Kl_3 by distribution law and hence Findthe value of GO of the above reaction
12.Compare the relative strength of CH_3COOH and $ClCH_2COOH$ from conductance measurements.
13. Determine the solubility (g/litre) of sparingly soluble lead sulphate from conductance measurements.
14. Titrate a given mixture of HCl and CH_3COOH against NaOH solution conductometrically..
15. Compare the relative strength of:

i) HCl

ii) H_2SO_4

by following the kinetics of inversion of cane sugar polarimetrically.

M.Sc. (Hons) Chemistry (Semester-II)
MHCH416: Inorganic Chemistry Practical-II

60 hrs. **Time: 6 Hrs.**
Max. Marks: 75+25 (Internal Assessment)

(Any 8 Complexes.)

1. Preparation of $Co(acac)_3$, its characterization using NMR, IR, UV-Vis and analysis of Cobalt (ref. J. Chem. Edu., 1980, 57, 7, 525)

2. Preparation of Co. $(acac\text{-}NO_2)_3$, its characterization using NMR, IR, UV-Vis and analysis of Cobalt. (ref. J. Chem. Edu., 1980, 57, 7, 525)

3. Preparation of $[Fe(H_2O)_6][Fe(N\text{-salicyldeneglycinato})_2]_2.3H_2O$, its characterization using IR, UV-Vis, magnetic susceptibility and analysis of Iron.(ref. InorganicaChimicaActa, 1977, 23, 35).

4. Preparation of $[Ni(NH_3)_6]Cl_2$its characterization using IR, UV-Vis, magnetic susceptibility and analysis of Nickel and NH_3. (ref. Marr and Rockett, 1972).

5. Preparation of $[Ni(ethylenediamine)_3]Cl_2$ its characterization using IR, UV-Vis, magnetic susceptibility and analysis of Nickel. (ref. Marr and Rockett, 1972, page 270).

6. Preparation of $[Fe(NO)(S_2CN(Et)_2)_2]$ its characterization using IR, UV-Vis, magnetic susceptibility and analysis of Fe(II). (ref. Marr and Rockett, 1972, page 262, J. Chem. Soc. 1962, 84, 3404).

7. Preparation of octahedral and tetrahedral complexes of dichlorodipyridylcobalt(II), differentiate them using IR, UV and magnetic properties. Estimate Co(II) from one of them. (ref. Marr and Rockett, 1972, page 375, Inorganic Chemistry, 1966, 5, 615).

8. Preparation of $VO(acac)_2$and its piperidine complex, characterize using IR, UV and magnetic moment. Estimate for V(IV). (ref. Marr and Rockett, 1972, 243).

9. Preparation of diaquotetraacetataocopper(II), magnetic susceptibility IR and UV-Vis, analysis of Copper(II).

10. Preparation of cis- and trans- potassium dioxalatodiaquochromate(III). Interpretation of IR, UV and magnetic properties.Estimation of Chromium. (ref. Marr and Rockett, 1972, page 386).

11. Preparation of $HgCo(NCS)_4$, its IR and measure its magnetic moment. (ref. Marr and Rockett, 1972, page 365).

12. Preparation of sodium tetrathionate, interpretation of its IR and analysis using potassium iodate. (ref. Marr and Rockett, 1972, page 214).

13. Preparation of Potassium dithionate, interpretation of its IR and analysis using potassium iodate. (ref. Marr and Rockett, 1972, page 214).

14. Preparation of bis(acetylacetonato)copper(II), UV-Vis, and IR, magnetic studies, Demonstration of Jahn Teller effect by solution spectral studies. (ref. Bull. Chem. Soc. Japan, 1965, 29, 852).

15. Preparation of salicylamide complexes of Copper(II). IR, UV, magnetic data and analysis of Cu(II). (ref. Indian J. of Chem., 1977, 15A, No. 5, 459; ibid, 1971, 9, 1396).

16. To prepare a macrocyclic ligand 5,7,7,12,14,14-hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-dienedi(hydrogeniodide) and its complex with Ni(II). Study IR, NMR and UV-Vis of ligand and complex and magnetic properties of complex. To analyze for Ni and I. (J. Chem. Edu. 1977, 79, 581).

17. Preparation and resolution of tris (ethylenediamine) cobalt (III). UV-Vis, NMR, IR, optical rotation of the resolved complexes. ((ref. Marr and Rockett, 1972, page 386).

Recommended Book:

1. B.N. Figgis, Introduction to Ligand Field, Wiley Eastern.
2. A.B.P. Lever, Inorganic Electronic Spectroscopy, Elsevier.
3. A.Earnshaw, Introduction to Magnetochemistry, Academic Press.
4. J.E. Huheey, Inorganic Chemistry Principles of Structure and Reactivity, Harper Interscience.
5. R.S. Drago, Physical Medhod in Chemistry, W.B.Saunders Company.
6. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, Wiley Int