

UNIV. DEPTT. OF CHEMISTRY
KOLHAN UNIVERSITY, CHAIBASA

Draft Copy of
Syllabus of M.Sc. Chemistry

**Under Choice Based Credit System
(CBCS)**

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Chemistry

M.Sc.

Semester – I

CC – 1

Analytical Chemistry

Full Marks – 70

Time : 03 Hours

1. Eight questions are to be set at least one question from each chapter.
2. Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc 10 question of 1 mark each (Compulsory).
3. Any Four questions out of the remaining Seven questions to be answered carrying 15 marks each.

Analytical Chemistry

I. Principles of Inorganic Analysis

- a) Strong and weak electrolytes, ionic equilibria solubility and solubility product, common ion effect, Principle and their application in qualitative inorganic analysis, Factors governing complete precipitation, partial precipitation, co-precipitation, Hydrolysis of salt.
- b) Interfering radicals : Detection, Interference and removal, Principle behind systematic qualitative inorganic analysis.
- c) Thermal Analysis (i) T.G.A. (Thermogravimetric Analysis) (ii) DTA (Differential Thermal Analysis) Theory & Working Principle.

II. Principles of Organic Analysis

Detection of elements and functional groups in organic compounds, separation of compounds from the mixture, Distillation, Fractional Distillation, Distillation under reduced Pressure, Steam Distillation, Principle of Solvent extraction, Distribution Law.

Unit Process : Nitration, Acetylation, Sulphonation, Reduction, Oxidation, Hydrolysis and Esterification.

Estimation of (i) Phenol (ii) –OR (iii) –NH₂ (iv) Keto groups.

Determination of molecular weight of (i) Carboxylic Acid by silver salt method and (ii) Organic bases by platini chloride method.

III. Chromatography

Definition, general introduction on Principles of Chromatography, Different Methods of Extraction/separation technique

- i) Paper chromatography
- ii) Column chromatography
- iii) Thin layer chromatography
- iv) Gas chromatography
- v) High performance liquid chromatography
- vi) Ion exchange chromatography.

IV. Spectrophotometric Analysis

U.V – Visible spectrophotometry, Lambert-Beer's Law, use of Spectrophotometer in the determination of :

- (a) Percentage composition of a mixture
- (b) Ionization constant of acid base indicator.

(c) Composition of complex (Job's Method)

V. Use of conductometric & Potentiometric analysis

- a) Application of conductometric titration in the determination of
 - i) Dissociation constant of weak acid
 - ii) Basicity of weak acid.
 - iii) Hydrolysis constant of salts derived from weak acid & strong base and vice versa
 - iv) Velocity constant of saponification of ethyl acetate.
- b) Application of potentiometric analysis in the determination of
 - i) Solubility & solubility product of sparingly soluble salt
 - ii) pH soluble salts
 - iii) instability constant of complex.

VI. Data analysis

Errors, classification of errors, elimination & minimization of errors, accuracy. Precision, Mean deviation, standard deviation Relative standard deviation, Median, Average deviation from mean, co-efficient of variation, Refection of data, statistic test of data – F. Test, T. Test, correlation, Regression.

Books Suggested

1. Fundamentals of Analytical Chemistry – D.O. Skoog, D.M. West.
2. Qualitative Analysis, Vogel.
3. Analytical Chemistry – C.D. Christian, J. Wiley.
4. Analytical Chemistry Principle – J.H. Kennedy, W.B. Saunders.
5. Quantitative Analysis, Vogel.

Sessional Internal Assessment (SIA) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry

M.Sc.

Semester – I

Core Course – 2

(Inorganic Chemistry)

Full Marks – 70

Time : 03 Hours

1. Eight questions are to be set at least one question from each chapter.
2. Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc 10 question of 1 mark each (Compulsory)
3. Any Four questions out of the remaining Seven questions to be answered carrying 15 marks each.

I. Stereochemistry and Bonding in Main Group Compounds 12 Hrs

Quantum mechanical treatment of hydrogen molecule, important features and limitations of Heitler London theory, Pauling and Slater's theory. VSEPR theory: limitation and applications, molecular orbital theory, Walsh diagrams (tri-atomic molecules type AH₂), dπ-pπ bonds, Bent rule and energetic of hybridization, some simple reactions of covalently bonded molecules, Atomic Inversion, Berry Pseudorotation.

II. Metal – Ligand Equilibria in Solution 08 Hrs

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

III. Reaction Mechanism of Transition Metal Complexes 15 Hrs

Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories. Kinetics of octahedral substitution. Acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, reactions without metal ligand bond cleavage. Substitution reaction in square planar complexes, the trans effect, mechanism of substitution reactions, Mechanism of redox reactions and its application in bioinorganic Chemistry, electron transfer reactions, cross reactions and Marcus-Hush theory..

IV. Metal – Ligand Bonding 15 Hrs

Limitations of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, Jahn-Teller effect, π – bonding and molecular orbital theory.

V. Electronic Spectra and Magnetic Properties of Transition Metal Complexes 15 Hrs

Spectroscopic ground states, correlation, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d¹ – d⁹ states), calculations of Dq, B and β parameters, charge transfer spectra, spectroscopic method of

assignment of absolute configuration in optically active metal chelates and their stereochemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

VI. Metal π Complexes

8 Hrs

Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls, preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes, tertiary phosphines as ligand.

Books Suggested

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson. John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamom.
4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
5. Magneto Chemistry, R.L. Cariin, Springer Vertag.
6. Comprehensive Coordination Chemistry, Q. Wilkinson, R.D. Gillars & J.A. McCleverty, Perganom.
7. UGC Advanced Inorganic Chemistry, S.K. Agarwal & Kimati Lal.
8. Inorganic chemistry – James E. Houge Elesevier.

Sessional Internal Assessment (SIA) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry
M.Sc.
Semester – I
Core Course - 3

(Organic Chemistry)

Full Marks – 70

Time : 03 Hours

1. Eight questions are to be set at least one question from each chapter.
2. Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc 10 question of 1 mark each (Compulsory)
3. Any Four questions out of the remaining Seven questions to be answered 15 marks each.

I. Nature of Bonding in organic Molecules and reaction mechanism 12 Hrs

Delocalized Chemical bonding conjugation, cross conjugations inductive resonance effect, hyper conjugation, tautomerism.

Introduction to Aromaticity in benzenoid and non-benzenoid compounds, Three membered, five membered and seven membered compound, alternate and non-alternate hydrocarbon, Huckel's rule, energy level of π molecular orbitals, annulenes, azulenes, anti-aromaticity, ψ aromaticity, homo-aromaticity, PMO approach for aromaticity.

Bonds weaker than covalent-addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes.

II. Reaction Mechanism : Structure and Reactivity 12 Hrs

Type of mechanisms, types of reaction, thermodynamic and kinetic requirements, thermodynamic and kinetic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, Carbocation, carbon ion, Free radical, Carbene Nitrenes, Arynes – generation, structure and their stability, methods of determining mechanisms.

III. Aliphatic Nucleophilic Substitution 10 Hrs

The S_N^2 , S_N^1 , mixed S_N^1 and S_N^2 and SET mechanisms.

The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance. Classical and non-classical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements. Application of NMR spectroscopy in the detection of carbocations. The S_N^1 mechanism.

Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon.

IV. Aromatic Nucleophilic substitution

The S_NAr , S_N1 , benzyne and $S_{RN}1$ mechanisms. Reactivity-effect of substrate structure, leaving group and attacking nucleophile. The von – Richter, Sommelet Hauser, and Smiles rearrangement.

V. Aliphatic and aromatic Electrophilic substitution 10 Hrs

Bimolecular mechanisms – S_E^2 and S_E^1 mechanism, electrophilic substitution accompanied by double bond shifts. Effects of substrates, leaving group and the solvent polarity on the reactivity.

Aromatic Electrophilic substitution : The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring system. Quantitative treatment of reactivity in substrates and electrophilics. Diazonium coupling, Gattermann-Koch reaction.

Book Suggested

1. Advanced Organic Chemistry - Reaction, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.
5. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice – Hall.
6. Modern Organic Reaction, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman & J.M. Coxon, Blackie Academic & Professional.
8. Pericyclic Reaction, S.M. Mukherji, Macmillan, India.
9. Reaction Mechanism in Organic Chemistry, S.M. Mukharji and S.P. Singh, Macmillan.
10. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
11. Stereochemistry of Organic Compounds. P.S. Kalsi, New Age International.
12. Mechanism of Organic reactions, K.S. Mukherjee, Books and Allied (P) Ltd. Kolkata.
13. Photo chemistry and Pericyclic Reactions, Jagadamba Singh and Jaya Singh, New Age International Publishers.

Sessional Internal Assessment (S/A) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry
M.Sc.
Semester – I
Core Course - 4
(Physical Chemistry)

Full Marks : 70

Time : 03 Hours

1. Eight questions are to be set at least one question from each chapter.
2. Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc 10 question of 1 mark each (Compulsory)
3. Any Four questions out of the remaining Seven questions to be answered carrying 15 marks each.

I. Quantum Chemistry

20 Hrs

A. Introduction to Exact Quantum Mechanical Results

The Schrodinger equation and the postulates of the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz..., particle in a box, the harmonic oscillator, the rigid rotor. The hydrogen atom.

B. Angular Momentum

Ordinary angular momentum, generalized angular momentum, Eigen functions for angular momentum, Eigen values of angular momentum, operator using ladder operators, Commutation relations, addition of angular momenta, spin, antisymmetry and Pauli's exclusion principle.

C. Electronic Structure of Atoms

Electronic configuration, Russell – Saunders terms and coupling schemes, Slater – Condon parameters, term separation, energies of the p^n configuration, term separation energies for the d^n configuration, magnetic effects : spin – orbit coupling and Zeeman splitting, introduction to the methods of self – consistent field. The virial theorem.

D. Molecular Orbital Theory

Huckel theory of conjugated systems, bond order and charge density calculations, Application to ethylene, butadiene, cyclopropenyl radical, cyclobutadiene etc. Introduction to extended Huckel theory.

II. Thermodynamics

20 Hrs

A. Classical Thermodynamics

Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties ; partial molar free energy, partial molar heat content and their significances. Determination of these quantities. Concept of fugacity and determination of fugacity. Non-ideal systems : Excess functions for non-ideal solution. Activity, activity coefficient.

B. Statistics Thermodynamics

Concepts of distribution, Thermodynamic probability and most probable distribution. Ensemble Averaging postulates of ensemble Averaging. Canonical, grand Canonical and microcanonical ensembles, corresponding distribution laws (using Lagrange's method of α , β undetermined multipliers). Partition function – translational, rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions. Applications of partition functions. Heat capacity behaviour of solids-chemical equilibria and equilibrium constant in terms of partition function, Fermi Dirac statistics – distribution law and applications to metal. Bose – Einstein statistics – distribution law and application to helium.

III. Chemical Dynamics

15 Hrs

Method of determining rate laws, collision theory of Bimolecular reactions. steric factor, activated complex theory, Arrhenius equation and the activated complex theory ; ionic reaction, kinetic salt effects, steady state kinetics and thermodynamic control of reactions, Enzyme reactions, study of the fast reaction by various methods. Photochemical reaction of H_2 and Cl_2 , H_2 and Br_2 , Pyrolysis of CH_3CHO , C_2H_6 .

Books Suggested

1. Physical Chemistry, P.W. Atkins. ELBS.
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Chemical kinetics, K.J. Laidler, McGraw-Hill.
5. Kinetics and Mechanism of Chemical Transformation, J. Rajaraman and J. Kuriacose, Mcmillan.
6. Modern Electrochemistry Vol.-II, J.O.M. Bockris and A.K.N. Reddy, Plenum.
7. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.
8. Advanced Physical Chemistry, Gurtu & Gurtu, Pragati Prakashan.
9. Quantum Chemistry, R.K. Prasad
10. Advanced Physical Chemistry, D.N. Bajpai.

Sessional Internal Assessment (SIA) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry

M.Sc.

Semester – I

Full Marks – 100

Core Course Practical – 5

Time : 06 Hours

(Inorganic Chemistry Practical)

Two experiments from the following should be set.

1. Cent per cent quantitative Analysis of the following (i) dolomite (ii) cement (iii) pyrolusite
2. Quantitative analysis of (i) Haematite by KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ (ii) common solder and (iii) brass
3. Estimation of the following :
 - (a) Magnesium by E.D.T.A. methods (volumetrically)
 - (b) Zinc by potassium ferrocyanide (volumetrically)
 - (c) Nickel by dimethylglyoxime (gravimetrically)
 - (d) Manganese in steel by sodium bismuthate method.
4. Preparation of the following metal complexes & their studies by IR, electronic spectra, molar absorptivity, ESR & magnetic susceptibility measurement.
 - (a) Hexamine cobaltic chloride.
 - (b) Sodium nitroprusside.
 - (c) Prussian blue
 - (d) Potassium trioxalatoferrate (III) $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$
 - (e) Nickel Dimethylglyoxime. $\text{Ni}(\text{dimg})_2$
 - (f) To determine moisture content pH, organic carbon in the soil.

Book suggested

1. Guide to laboratory establishment for plant nutrient analysis by M.R. Motsara & R.N. Roy
2. Qualitative Analysis, Vogel.
3. Quantitative Analysis, Vogel.

Experiments – 40 + 40 Marks

Viva-Voice – 10 Marks

Notebook – 10 Marks

Chemistry

M.Sc.

Semester – II

CC – 6

(Spectroscopy)

Full Marks : 70**Time : 03 Hours**

- Eight questions are to be set at least one question from each chapter.
- Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc 10 question of 1 mark each (Compulsory)
- Any Four questions out of the remaining Seven questions to be answered carrying 15 marks each.

- I. Vibrational Spectroscopy** 12 Hrs.
- A. Infrared Spectroscopy**
Review of linear harmonic oscillator, Vibrational energies of diatomic molecules, zero point energy, force constant and bond strength; anharmonicity, Morse potential energy diagram, Vibration-rotation Spectroscopy, P, Q, R, branches. Breakdown of Oppenheimer approximation; Vibrations of polyatomic molecules. Selection rules, normal modes of Vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region, metal – ligand vibrations, normal co-ordinate analysis.
- B. Raman Spectroscopy**
Classical and quantum theories of Raman effect. Pure rotational, vibrational and vibrational rotational Raman spectra, selection rules mutual exclusion principle. Resonance Raman Spectroscopy, Coherent Anti stokes Raman Spectroscopy (CARS).
- II. Electronic Spectroscopy** 12 Hrs.
- A. Atomic Spectroscopy**
Energies of atomic orbitals, vector representation of momenta and vector coupling spectra of hydrogen atom and alkali metal atoms.
- B. Molecular Spectroscopy**
Energy levels, molecular orbitals, vibronic transition, vibrational progressions and geometry of the excited states, Franck – Condon Principle, electronic spectra of polyatomic molecules. Emission spectra; radiative and non-radiative decay, internal conversion, metal complexes, charge – transfer spectra.
- III. Nuclear Magnetic Resonance Spectroscopy** 12 Hrs.
Nuclear spin, Nuclear resonance, saturation shielding of magnetic nuclei, chemical shift and its measurement, factors influencing chemical shift, deshielding, spin-spin interaction, factors influencing coupling constant 'J' Classification (ABX, AMX, ABC, A₂B₂ etc.), spin decoupling; basic ideas about instrument, NMR studies of nuclei other than proton – ¹³C, ¹⁹F and ³¹P. FT NMR, advantage of FT NMR, use of NMR in medical diagnostics.
- IV. Electron Spin Resonance Spectroscopy** 08 Hrs.
Basic principle, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and McConnell relationship measurement techniques, applications.

V. X-ray Diffractions

12 Hrs.

Bragg condition, miller indices, Laue method, Bragg method, Debye – Scherer method of X-ray structural analysis of crystals, index reflections identification of unit cells from systematic absences in diffractions pattern. Structures of simple lattices and X-ray intensities, structure factor and its relation analysis, absolute configuration of molecules, Ramchandran diagram.

Book Suggested

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Applied electron Spectroscopy for Chemical Analysis, Ed. H. Windawi and F.L. Ho. Willy Inter science.
3. NMR, NOR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
4. Physical method in Chemistry, R.S. Drago, Saunders College.
5. Chemical Application of Group Theory, F.A. Cotton.
6. Introduction to Molecular Spectroscopy, Q.M. Barrow, McCraw Hill.
7. Basic Principle of Spectroscopy, R.Chang, McOraw Hill.
8. Theory and Application of UV Spectroscopy, H.H. Faffe and M. Orchin, IBH-Oxford.
9. Introduction of Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.
10. Introduction of Magnetic Resonance, A. Carrington and A.D. Maclachalan, Harper & Raw.

Sessional Internal Assessment (SIA) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry**M.Sc****Semester – II****Core Course – 7****(Group Theory & Bioinorganic)****Full Marks – 70****Time : 03 Hours**

- Eight questions are to be set at least one question from each chapter.
- Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc 10 question of 1 mark each (Compulsory)
- Any Four questions out of the remaining Seven questions to be answered 15 marks each.

I. Symmetry and Group Theory in Chemistry

12 Hrs.

Symmetry elements and symmetry operation, definitions of group, subgroup, relation between order of a finite group and its subgroup. Conjugacy relation and classes. Point symmetry group. Schonflies symbols. Representation of groups by matrices (Representation for the C_n , C_{nv} , C_{nh} , D_{nh} etc. groups to be worked out explicitly) Character of a Representation. The great orthogonality theorem (without proof) and its importance. Character tables their use; spectroscopy.

Bio Inorganic**I. Metal Ions in Biological Systems**

05 Hrs.

Concept of essentiality. Essential & trace metals role of metals ion in biological process. Active and passive transport of metal ion, across bio membrane Na^+/K^+ pump, Bio ligands, chemistry of physiological buffers.

II. Bioenergetics and ATP Cycle

06 Hrs.

DNA polymerization, glucose storage, phosphoglucomutase activity, Role of phosphate and glucose oxidation, Glycolysis, Krebs cycle and aconitase activity, metal complexes in transmission of energy; chlorophylls, photosystem I and photosystem II in cleavage of water, Model system of chlorophyll, Dark reaction photosynthesis in bacteria.

III. Transport and Storage of Dioxygen

08 Hrs.

Heme proteins and oxygen uptake, structure and function of haemoglobin, myoglobin, hemocyanins and hemerythrin, model synthetic complexes of iron, cobalt and copper, bohr effect cyanide poisoning and its remedy.

IV. Electron Transfer in Biology

06 Hrs.

Structure and function of metalloproteins in electron transport processes – cytochromes and iron-sulphur proteins, synthetic models.

Nitrogenase : Biological Nitrogen fixation, molybdenum nitrogenase, spectroscopic and other evidence, other nitrogenases model system.

V. Biochemistry of non-metals

05 Hrs.

Non-metals in structure use, biomineralisation, biological role of some trace non-metal B, Si, S, Se, As, F, Cl, Br biological importance of nitric oxide. (NO).

Book Suggested

1. Principles of Bio-inorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. Bio-inorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books
3. Inorganic Bio-Chemistry vols A and II, Ed. G.I..... Eichhorn, Elsevier.
4. Progress in Inorganic Chemistry, Vols 18 and 3S Ed. J.J. Lippard, Wiley.
5. Enzymatic Reaction Mechanisms, C. Walsh, W.H. Freeman.

Sessional Internal Assessment (S/A) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry
M.Sc.
 Semester – II
 Core Course – 8
(Organic Chemistry)

Full Marks – 70**Time : 03 Hours**

1. Eight questions are to be set at least one question from each chapter.
2. Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc 10 question of 1 mark each (Compulsory)
3. Any Four questions out of the remaining Seven questions to be answered 15 marks each.

I. Stereochemistry 12 Hrs

Conformational analysis of cycloalkanes, decalins, steric strain due to unavoidable crowding. Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape.

II. Addition to Carbon-Carbon Multiple Bonds and Carbon Hetero Multiple Bonds 10 Hrs

Mechanistic and stereochemical aspects of addition reactions involving electrophiles. Nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidation.

III. Addition to Carbon Hetero Multiple Bonds

- a) Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction.
- b) Mechanism of condensation reaction involving enolates-Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.

Hydrolysis of esters and amides, ammonolysis of esters.

IV. Elimination Reaction 05 Hrs

The E2, E1 and E1cB mechanisms and their spectrum. Orientation of the double bond. Reactivity-effect of substrate structures, attacking base, the leaving group and the medium.

Mechanism and orientation in pyrolytic elimination.

V. Pericyclic Reactivity 15 Hrs

Thermal and photochemical pericyclic reaction, conrotation and disrotation, Electrocyclic closure and opening in $4n + 2$ systems woodward Hoffmann selection rule for electrocyclic reaction and examples. Cyclo addition reactions : Suprafacial and antarafacial interactions $\pi^2 + \pi^2$ and $\pi^4 + \pi^2$ cyclo additions. Diels Alder reactions, Woodward – Hoffmann selection rule for cyclo addition reaction and examples. Mechanism by orbital symmetry correlation diagrams. Frontier Molecular orbital (FMO) Theory, Endo – exo selectivity in Diels - Alder reaction and its explanations by FMO theory. Sigma tropic reactions mechanism of sigma tropic reaction cope and claisen rearrangement.

Book Suggested

14. Advanced Organic Chemistry - Reaction, Mechanism and Structure, Jerry March, John Wiley.
15. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum.
16. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
17. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.
18. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice – Hall.
19. Modern Organic Reaction, H.O. House, Benjamin.
20. Principles of Organic Synthesis, R.O.C. Norman & J.M. Coxon, Blackie Academic & Professional.
21. Pericyclic Reaction, S.M. Mukherji, Macmillan, India.
22. Reaction Mechanism in Organic Chemistry, S.M. Mukharji and S.P. Singh, Macmillan.
23. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
24. Stereochemistry of Organic Compounds. P.S. Kalsi, New Age International.
25. Mechanism of Organic reactions, K.S. Mukherjee, Books and Allied (P) Ltd. Kolkata.

Photo chemistry and Pericyclic Reactions, Jagadamba Singh and Jaya Singh, New Age International Publishers.

Sessional Internal Assessment (SIA) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry
M.Sc.
Semester – II
Core Course - 9
(Physical Chemistry)

Full Marks : 70**Time : 03 Hours**

1. Eight questions are to be set at least one question from each chapter.
2. Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc 10 question of 1 mark each (Compulsory)
3. Any Four questions out of the remaining Seven questions to be answered carrying 15 marks each.

I. Surface Chemistry

10 Hrs

A. Adsorption

Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation) surface films on liquids (Electro – kinetic phenomenon), catalytic activity at surfaces.

B. Macromolecules

Polymer – definition, types of Polymers, electrically conducting fire resistant liquid crystal polymers, kinetics of polymerization, mechanism of polymerization. Molecular mass. Number and mass average molecular mass. Determination of molecular mass of polymer using (osmometry, viscometer, diffusion and light scattering method sedimentation, chain configuration of macromolecules, calculation of average dimensions of various chain structures.

II. Electrochemistry

10 Hrs

Electrochemistry of solutions. Debye-Huckel-Onsager treatment and its extension ion solvent interaction. Debye-Huckel-Jerum mode. Thermodynamics of electrified interface equations. Derivation of electro-capillarity, Lippmann equations. (surface excess), methods of determination. Structures of electrified interface, electrical double layer and zeta potential. Guoy – chapman, stern, Graham – Devanathan – Mottwatts, Tobin, Bockris, devanathan models. Over potentials, exchange current density, derivation of Butler - Voimer equation, Tafel equation.

Debye – Huckel theory for activity coefficient of electrolytic solutions; determination of activity and activity coefficients; ionic strength.

III. Magneto Chemistry and Magnetic Properties of substances.

Magneto chemistry, magnetic permeability, magnetic susceptibility Relation between magnetic susceptibility and magnetic moment applications of magnetic susceptibility.

Types of substances – Paramagnetic substances diamagnetic substances and Ferromagnetic substances. Theory of Diamagnetism – Langevin's theory. Theory of Ferromagnetism – Welss theory of ferromagnetism, measurement of magnetic susceptibility, magnetic susceptibility is an additive and substitutive property.

Books Suggested

11. Physical Chemistry, P.W. Atkins. ELBS.
12. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
13. Quantum Chemistry, Ira N. Levine, Prentice Hall.
14. Chemical kinetics, K.J. Laidler, Megraw-Hill.
15. Kinetics and Mechanism of Chemical Transformation, J. Rajaraman and J. Kuriacose, Mcmillan.
16. Modern Electrochemistry Vol.-II, J.O.M. Bockris and A.K.N. Reddy, Plenum.
17. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.
18. Advanced Physical Chemistry, Gurtu & Gurtu, Pragati Prakashan.
19. Quantum Chemistry, R.K. Prasad
20. Advanced Physical Chemistry, D.N. Bajpai.

Sessional Internal Assessment (SIA) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry

M.Sc.

Semester – II

Core Course – 10 (Practical)

Full Marks – 100

Time : 06 Hours

Group – A

(Organic Chemistry Practical)

One experiment from the following should be set.

I. Organic Qualitative Analysis

Identification of organic compounds contain not more than two functional; groups using chemical analysis.

II. Preparation of organic compounds using methods not involving more than two steps :

- (i) Preparation of Methyl Orange
- (ii) Preparation of 2, 4, 6 Tribromo phenol from Aniline
- (iii) Preparation of p-Nitro aniline from Acetanilide
- (iv) Preparation of Sulphanilic acid from Aniline

III. Estimation of

- (i) Glucose
- (ii) Carbonyl group using 2, 4 Dinitrophenyl hydrazine (DNP)

Group – B

(Physical Chemistry Practical)

One experiment from the following should be set.

I. Measurement of density of gases and vapours

Victor meyer's method determination of molecular weight of acetone, Chloroform, benzene, (mixture).

II. Determination of molecular weight of substances

Backmann's freezing point method

III. Viscosity of Liquids and Solution by Ostwald tube.

Determination of percentage composition of a mixture of two liquids.

IV. Surface Tension of Liquids and Solutions

- (a) Determination of surface tension of the given liquid by drop number method.
- (b) Determination of Parachor

V. Thermochemistry

- (a) Determination of water equivalent of a calorimetry
- (b) Determination of Heat of Neutralization of :
 - (i) Strong acid and strong Base (HCl and NaOH)
 - (ii) Weak acid and strong Base (NaOH and CH₃COOH)

VI. Order of Reaction

- (a) Determination of rate constant of hydrolysis of an ester with an acid (Methylacetate and HCl)
- (b) Determination of the rate constant of saponification of ethylacetate by NaOH.

VII. Partition Co-efficient

Determination of partition coefficient of :

- (i) Benzoic acid between water and Benzene
- (ii) Iodine between water and Carbon tetrachloride.

Experiments

Group A – 40 Marks

Group B – 40 Marks

Notebook – 5 + 5 Marks

Viva-voce – 5 + 5 Marks

Chemistry

M.Sc.

Semester – III

Core Course – 11

Applications of Spectroscopy

Full Marks – 70

Time : 03 Hours

1. Eight questions are to be set at least one question from each chapter.
2. Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc 10 question of 1 mark each (Compulsory)
3. Any Four questions out of the remaining Seven questions to be answered 15 marks each.

Inorganic Chemistry

I. Vibrational Spectroscopy

Observed number of modes of vibrations, mode of bonding of ambidentate ligands, Ethyleneoliamine and diketo complexes. Theoretical group frequencies, Factors affecting group frequencies and band shapes (Physical state Vibrational Coupling, Electrical effects, Resonance, Inductive effects, Ring strain)

Application of IR to Distinction between the following :

- a) Ionic and coordinate anions such as NO_3^- , SO_4^{2-} and SCN .
- b) Lattice and coordinated water.

II. Electron Spin Resonance Spectroscopy

Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes (having one unpaired electron) including biological systems and to inorganic free radicals such as PH_4 , F_2 and $[\text{BH}_3]$.

III. Nuclear Magnetic Resonance of Paramagnetic Substances in Solution

The contact and pseudo contact shifts, factors affecting nuclear relaxation, some applications including biochemical systems, an overview of NMR of metal nuclides with emphasis on ^{195}Pt and ^{119}Sn NMR.

IV. Mossbauer Spectroscopy

- (a) Basic principles, spectral parameters and spectrum display.
- (b) Isomer shift, Electric Quadrupole Interactions, Application of the technique to the studies of (1) bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin. (2) Sn^{+2} and Sn^{+4} compounds nature of M-L bond, co-ordination number, structure and (3) detection of oxidation and in equivalent MB atoms.

Organic Chemistry

I. Ultraviolet and Visible Spectroscopy

Various electronic transitions (185-800 nm), Beer – Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes, Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds.

II. Infrared Spectroscopy

Instrumentation and sample handling. Characteristic vibrational frequencies of alkanes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance, FT, IR, IR of gaseous, solids and polymeric materials.

III. Nuclear Magnetic Resonance Spectroscopy

General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), chemical exchange, effect of deuteration, solvent effects. Fourier transform technique.

Carbon 13 NMR Spectroscopy

General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and Carbonyl carbon), coupling constants. Two dimension NMR spectroscopy – COSY, NOESY, DEPT, INEPT.

IV. Mass Spectrometry

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

Book Suggested

1. Physical methods for chemistry, R.S. Drago, Saunders Company
2. Structural methods in Inorganic Chemistry, E.A.V. Ebsworth, D.W.H. Rankin and S. Craddock, ELBS.
3. Infrared and Raman Spectra : Inorganic and Co-ordination Compounds, K. Nakamoto, Wiley.
4. Progress in Inorganic Chemistry vol. 8, Ed. F.A. Cotton, vol. 15, Ed S.J. Lippard, Wiley.
5. Transition Metal Chemistry eA.R.L. Carlin voi. S, Dekker
6. Inorganic Electronic Spectroscopy, A.P.B. Lever, Elsevier.

Sessional Internal Assessment (SIA) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry

M.Sc.

Semester – III

Core Course – 12

Industrial Chemistry

Full Marks – 70

Time : 03 Hours

1. Eight questions are to be set at least one question from each chapter.
2. Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc 10 question of 1 mark each (Compulsory)
3. Any Four questions out of the remaining Seven questions to be answered 15 marks each.

I. Portland Cement & Plaster of Paris

Introduction, Raw Materials, Important Process, Parameters for manufacturing good cement Clinker method of manufacturing cement, Dry process vs wet process, sequence of operation, characteristics of constitutional compounds, Additives of cement, Properties and testing of cement, General composition of ordinary portland cement, Reaction taking place in the rotary kiln, Thermodynamical changes taking place during cement formation.

Action of some chemicals concrete, Types of Portland cement and its derivatives, other type of cement, prestressed concrete post tensioning curing, Gyseum and its uses, Plaster of Paris, its manufacture & uses.

II. Corrosion

Corrosion and its economical aspects, thermodynamics of corrosion – Pourbaix diagram, Immunity, Corrosivity and Passivation, Mechanism and Kinetics of corrosion Evans diagram, Intrinsic and extrinsic forms of corrosion, Electro chemical method for corrosion testing.

Corrosion prevention techniques, metallic coatings, organic paints, varnishes, corrosion inhibitors, cathodic and anodic protection, corrosion in industries with reference to thermal power plants, mining and petroleum industries prevention of microbial corrosion.

III. Water Treatment

Sources of Water - Surface water, Ground water, sources of impurities in water, purification of water, insoluble and soluble impurities, bacteria, micro organism, algae oil.

Boiler feed water, defects caused in boiler by priming and foaming, caustic embrittlement scale formation due to silica.

Water analysis – Sampling of water, unit and their interrelation, Method of analysis for hardness, acidity alkalinity, chloride, fluoride, sulphate, phosphate, silica different forms of nitrogen dissolved CO_2 , O_2 and H_2S .

IV. Fuel

Definition, Essential requirement of a fuel. Modern concept of a fuel, classification of fuel, methods of processing of various fuel.

Solid fuel – Natural solid fuel, Artificial solid fuel, Wood, Charcoal, Coal, Advantage and disadvantage of solid fuel over liquid and gaseous fuel.

Analysis of coal, Proximate and ultimate analysis, uses of coal in various industry coke, charcoal,

Liquid fuel – Petroleum products, Gasoline, Kerosene oil, fuel oil, Benzols, coal tar, Diesel oil.

Gaseous Fuel – Natural and Artificial Gaseous fuel.

V. Advance Polymers

Solid and gas phase polymerization, Group transfer polymerization, Living free radical polymerization, Butyl rubber, styrene butadiene rubber, Telechelic polymers, Heterochain polymers, Ethylene Propylene diene rubber (EPDM), Thermosetting Resins, Ionomers, Hydrogel. Polymeric liquid, crystals, Polymeric gel, Heat resistant polymers, Multiphase polymeric systems graft and block, co-polymers, conducting polymers, types of conducting polymers, chemical and electro chemical routes of synthesis, Doping and dedoping of conjugated polymers solatrons and polaron formation in conducting polymers.

Bio and natural polymers, Proteins, nucleic acid, lipids, cellulose and polysaccharide. Medicinal and biomedical application of polymers.

VI. Industrial Waste Management

Definition, Classification, source and composition of solid, liquid and gaseous wastes, Hazardous and nonhazardous wastes, special waste material, storage and transport of waste, Transportation and collection system, management of waste, minimization, reuse, recycling, waste utilization and material recovery, treatment of wastes, biological treatment compostion, anaerobic digestion, combustion, incineration and land files, ultimate disposal.

Book Suggested

1. Industrial chemicals and Environment – Vishal publication, Jharkhand
2. Text book of Polymer Science – Third edition, Fred W. Billmeyer, JR.
3. Analytical chemistry by H. Kaur, Pragati Prakashan, Jharkhand
4. A Text book of Engineering chemistry – M.M Uppal, Khanna, Publisher, New Delhi.
5. The Management of hazardous substances in the environment Applied Science, K.L. Zirm.
6. Bio Conservation of waste Material to industrial products Elsevier, Amsterdam.
7. Industrial chemistry(organic and Inorganic industries) by Dr. B.K. Sharma. Goel publishing house, Meerut.

Sessional Internal Assessment (SIA) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry

M.Sc.

Semester – III

DSE - 1

Inorganic Chemistry (Special)**Full Marks – 70****Time : 03 Hours**

- Eight questions are to be set at least one question from each chapter.
- Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc 10 question of 1 mark each (Compulsory)
- Any Four questions out of the remaining Seven questions to be answered 15 marks each.

I. Alkyls and Aryls of Transition Elements

5 Hrs

Metal alkyl and aryl complexes, Preparative methods of σ -bonding organometallic compounds, stability and decomposition pathways, organocopper in organic synthesis.

Applications of organometallic compounds : Organometallic compounds in medicine, agriculture and industry, environmental aspects of organometallic compounds.

II. Compounds of Transition Metal – Carbon Multiple Bonds

12 Hrs

Alkylidenes, alkylidyne, low valent carbenes and carbynes-synthesis, nature of bond, structural characteristics, nucleophile and electrophilic reactions on the ligands, role of organic synthesis.

III. Transition metal π Complexes

18 Hrs

Transition metal π Complexes with unsaturated organic molecules, alkenes, alkynes, allyl, diene, dienyl, arene and trienyl complexes, preparations, properties, nature of bonding and structural features, important reactions relating to nucleophilic and electrophilic attack on ligands and to organic synthesis.

IV. Homogeneous Catalysis

14 Hrs

Stoichiometric reactions for catalysis: oxidative addition, reductive elimination, migratory insertion, 1,2 insertion, β -hydride elimination, reaction of coordinated ligands, homogeneous catalytic hydrogenation, Alkene metathesis (Grubbs catalyst), Zeigler-Natta Polymerization of Olefins, hydroformylation of olefin (oxo reaction), water-gas shift reaction, Monsanto ethanoic acid synthesis, oxopalladation reactions activation of C-H bond, Palladium-catalysed C-C bond-forming reactions..

V. Fluxional Organometallic Compounds

8 Hrs

Fluxionality and dynamic equilibrium in compounds such as η -olefine, η -allyl and dienyl complexes.

VI. Electronic structure of inorganic clusters

Structure and bonding in higher Boranes STYX number, carboranes, metallocarboran, Electron counting scheme for metal carbonyl clusters – LNCC's and HNCC's, Wades-Mingos-Lauher rule, calculation of no. of M M bond, isolobal analogy, Bonding in $[\text{ReC}_{18}]^{2-}$

Book Suggested

1. Principles and Application of Organometallic Chemistry, J.P. Collman, L.S. Hegsdus. J.R. Norton and R.G. Pinke, University Science Books.
2. The Organometallic Chemistry of the Transition Metals, R.H. Crabtree, John Wiley.
3. Metallo-organic Chemistry, A.J. Pearson, Wiley.
4. Organometallic Chemistry, R.C. Mehrotra and A. Singh, New Age International.

Sessional Internal Assessment (SIA) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry
M.Sc.
 Semester – III
DSE - 1
Organic Chemistry (Special)

Full Marks – 70**Time : 03 Hours**

- Eight questions are to be set at least one question from each chapter.
- Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc 10 question of 1 mark each (Compulsory)
- Any Four questions out of the remaining Seven questions to be answered 15 marks each.

- I. Alkaloids** 15 Hrs.
 Definition, nomenclature and Physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, Stereochemistry, synthesis and biosynthesis of the following : Atropine, Quinine and Morphine, Nicotine.
- II. Terpenoids and Carotenoids** 15 Hrs.
 Classification, nomenclature, occurrence, isolation, general methods of structure determination, Isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules : Citral, α -Terpineol, α -Pinene.
- III. Steroids** 15 Hrs.
 Occurrence, nomenclature, basic skeleton, Diel's Hydrocarbon and stereochemistry, Isolation, Structure determination and synthesis of Cholesterol, Androsterone, Testosterone, Oestrone, Progesterone, Biosynthesis of steroids.
- IV. Structural Effects on Reactivity** 06 Hrs.
 Linear Free Energy Relationship (LFER), The Hammett equation, Substituent constants, theories of substituent effects, Interpretation of σ -values. Reaction constant ρ . Derivations from Hammett equation. Dual-parameter correlation, inductive substituent constant, The Taft model. σ_1 and σ_R scales.
- V. Photo Chemistry** 10 Hrs.
 Principles of photochemistry : quantum yield, electronic states and transitions, selection rules, modes of dissipation of energy (Jablonski diagram), electronic energy transfer: Photosensitization and quenching process.
 Photochemistry of carbonyl compounds: Norrish Type-I and Norrish Type-II cleavages, Paterno-Buchi reaction. Photoreduction, Photo Fries rearrangement, Barton reaction.
 Photochemistry of olefins: cis-trans isomerizations, dimerizations,
 Photochemistry of arenes: Ring isomerization, photoaddition of alkenes to aromatic benzenoid compounds - 1, 2-, 1, 3- and 1, 4- additions.
- VI. Principles of Reactivity** 05 Hrs.
 Mechanistic significance of entropy, enthalpy and Gibbs free energy, Arrhenius equation. Transition state theory. Uses of activation parameters, Hammond's postulate. Bell-Evans-Polanyi principle. Potential energy surface model, Marcus theory of electron transfer. Reactivity and Selectivity principles.

VII. Reagent and its uses

06 Hrs.

Al- isopropoxide, Baeyer's reagent, Biborane, Dicyclohexyl carbodiimide, 2, 4-Dinitrofluorobenzene, Dithiane, Li-dialkylcuprate, Lithium diisopropylamide, Osmium tetroxide, Phenyl isothiocyanate, HIO₄, Raney nickel. Wilkinson's catalyst.

Sessional Internal Assessment (S/A) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry**M.Sc.****Semester – III****DSE - 1****Physical Chemistry (Special)****Full Marks – 70****Time : 03 Hours**

1. Eight questions are to be set at least one question from each chapter.
 2. Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc. 10 question of 1 mark each (Compulsory)
 3. Any Four questions out of the remaining Seven questions to be answered 15 marks each.
- I. Diffraction of X-rays by crystals** - Debye Scherrer method, indexing powder pattern for cubic and tetragonal crystals, rotating crystal method, Fourier transform and reciprocal lattices, Bragg equation in reciprocal. Lattice, neutron diffraction.
 - II. Metallic bonds** – free electron theory, bond theory, Fermi level, Brillouin zone, wave function for electrons in solids, metallic conductors, insulator, semiconductors (intrinsic & extrinsic), properties of junctions.
 - III. Super conductivity** – meissener effect, microscopic theory of super conductivity, conventional organic and high temp, super conductors, fullerenes, applications of superconductors transformation of order – disorder transitions, martensitic transition, polymorphic, transformation.
 - IV. Specific heat of solids** – classical theory, quantum theory of specific heats – einstant and debye theories, characteristic temp. and its calculation, T-law solid state reaction, laws governing nucleation. Homogeneous and heterogenous nucleation, thermodynamic barrier.
 - V. Polymer solution** - thermodynamics of polymer solution, molar mass and molar mass distribution, methods of measuring molar masses, micelle formation and hydrophobic interaction. Electrically conducting polymers, electrochemical polymerization, band structures of polymers mechanism of conduction in polymers, doping of polymers, application of conduction polymers.
 - VI.** Polymers liquid crystals nematic, cholesteric and smectic phases, liquid crastoline order of the main chain and of the side groups in polymers, synthesis and properties of polymers liquid crystals, liquid crystalline order in biological material.
 - VII. Surface chemistry** – surface films, BET isotherm for, multilayers & its derivation, kinetics of surface processes, unimolecular and bimolecular surface reaction, electrocapillarity, electro kinetic effect, statistical mechanics of adsorption.

Book Suggested

1. Crystallography – Philips
2. Solid State Chemistry – Garner (Butterworth; London)
3. Solid State Chemistry – D.K. Chakraborty (New Age Publication)
4. Solid State Chemistry – N.B Hannay (Prentice Hall, New Jersey)
5. Physical Chemistry – Waller J. Moore
6. Physical Chemistry – P.W. Atkins
7. Principle of polymer Chemistry – Cornell, P.J. Flory (University Press)
8. Handbook of Conducting polymers Vol I & II, T.A. Skolhia.

Sessional Internal Assessment (S/A) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry

M.Sc.

Semester – III

DSE - 2 (Practical)

Inorganic Chemistry (Special)

Full Marks – 100

Time : 06 Hours

Two questions are to be set

I. Quantitative Analysis

- (i) Analysis of alloys (brass type metal, solder, gun metal) Cement, Steel Using conventional chemical analysis / and physical techniques (if possible). (Preferably one alloy and cement analysis may be carried out).
- (ii) Analysis of two cation-system using complexones.
- (iii) Colorimetric estimation of cation/anions.

II. Separation Techniques

- (i) Ion exchange : Separation of inorganic cations/anions (2 or 3 components).
- (ii) Chromatographic Separation.
 - (a) Cd – Zn (b) Zn – Mg

III. Preparation of inorganic complexes, their purification, Molecular Weight determination and elucidation of the structures by available physical methods.

- (i) Preparation of Cobalt (III) complexes
 - (a) $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$
 - (b) $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$
 - (c) $[\text{Co}(\text{NH}_3)_5\text{ONC}]\text{Cl}_2$

Experiments – 80 Marks

Viva-Voice – 10 Marks

Notebook – 10 Marks

Chemistry

M.Sc.

Semester – III

DSE - 2 (Practical)

Organic Chemistry (Special)

Full Marks – 100

Time : 06 Hours

Two questions are to be set

I. Organic Synthesis and Extraction of Organic Compounds from Natural Sources

The students are expected to carry out 6 to 8 organic preparation (usually involving not more than two steps). Some of the illustrative experiments are listed below:

1. Extraction of caffeine from tea leaves (Ref. Experimental Organic Chemistry H Dupon Durst. George W. Gokel, p.464 MnGraw Hall Book Co., New York). Students should be asked to purify the crude sample, check the purity on TLC single spot and/or get the pmr scanned and interpret. (Three methyl singlets and 1 methine singlet).
2. Isolation of casein from milk (Try some typical colour reactions of proteins).
3. Isolation of lactose from milk (check purity of sugar by TLC and PC and calculated Rf value).
4. Isolation of nicotine dipicrate from tobacco.
5. Synthesis of 3-nitrobenzoic acid from benzoic acid. (Ref.: ibid, p.246-247 and 443-448).
Aim to demonstrate the process of nitration, esterification and saponification of ester.
Make a comparative study of IR and PMR spectra of benzoic acid, methyl benzoate, methyl nitrobenzoate, if possible.
6. Preparation of Indigo from anthranilic acid.
7. Cannizzaro reaction of 4-chlorobenzaldehyde (Ref.: ibid. p. 397-400).
Aim to demonstrate technique of isolation of two products from the reaction mixture and the procedure of intermolecular hydride transfer.
Make a comparative study of IR and PMR spectra of 4-Chlorobenzyl alcohol, if possible.
8. Synthesis of benzanilide from benzene (Ref.: ibid. p. 775, 812)
Aim to carry out Friedel Crafts Acylation (anhydrous conditions) and Beckmann rearrangement.
Make a comparative study of IR and PMR spectra of benzene, benzophenone, benzophenone oxime and benzanilide (N-H stretching vibration typical of a secondary amide) if possible.

Experiments – 80 Marks

Viva-Voice – 10 Marks

Notebook – 10 Marks

Chemistry
M.Sc.
Semester – III
DSE – 2 (Practical)
Physical Chemistry (Special)

Full Marks – 100

Time : 06 Hours

Two questions are to be set

I. Conductometry

- (a) To determine the solubility and solubility product of a sparingly soluble salt.
- (b) To verify Onsager equation for a uni-univalent electrolyte in aqueous solution.
- (c) To titrate a mixture of HCl, CH₃COOH and CuSO₄ with NaOH.
- (d) To determine the rate constant of saponification of an ester by NaOH.

II. Potentionmetry

- (a) To determine the solubility and solubility product of AgCl in water.
- (b) To determine the E° of Zn/Zn²⁺, Cu/Cu²⁺ Electrodes.
- (c) To determine the basicity of polybasic acid and its dissociation constant.
- (d) To investigate the complex formed between CuSO₄ and NH₃.

III. Polarimetry

- (a) Determination of specific rotation of sucrose.
- (b) Study of inversion of cane sugar in acid medium.

IV. Refractometry

- (a) To verify mixture law of refraction.
- (b) To determine the composition of an unknown solution.

V. Cryoscopy

- (a) To determine to activity of a non-electrolyte by freezing point method.
- (b) To determine the mean activity co-efficient of KCl by freezing point method.

VI. Conductivity

- (a) Determination of cell Constant
- (b) Determination of equivalent conductivity of weak acid (acetic and succinic acid) at several concentrations and calculation of the dissociation constant of the acid.
- (c) Determination of the basicity of an acid (Citric acid and Oxalic acid)
- (d) Titration of :
 - (i) Strong acid and Strong Base (HCl and NaOH)
 - (ii) Weak and Strong Base (CH₃COOH and NaOH)

VII. E.M.F.

- (a) Determination of Single electrode potential of Cu/Cu²⁺
- (b) Determination of e.m.f of conc. cell
- (c) Potentiometric Titration of acid-base

Experiments – 80 Marks

Viva-Voice – 10 Marks

Notebook – 10 Marks

Chemistry

M.Sc.

Semester – III

Project Work

Full Marks – 100

The paper will consist of

- (a) Field work / Lab work related to the project.
- (b) Preparation of draft copy of dissertation based on the work undertaken.
- (c) Presentation of project work in the seminar on the assigned topic in the Department of Chemistry, Kolhan University, Chaibasa & opened viva there on.

NB : The students will select topics for the project work in consultation with a teacher of the Department.

TOPICS

Project work related to the following Industrial / Socially relevant topics may be given to the students.

- (a) Environmental study such as (i) Analysis of Water, Soil, Air etc.
- (b) Industrial goods analysis such as
 - (i) Analysis of Cement.
 - (ii) Analysis of Haematite.
 - (iii) Analysis of minerals available in Jharkhand State.
 - (iv) Synthesis of useful commercial products based on raw materials available in Jharkhand State such as Lac, Limestone etc.
 - (v) Isolation of constituents of medicinal plants available Jharkhand State.

Each student has to submit draft copy of dissertation work

NB : the seminar will be held in the Department of Chemistry, Kolhan University, Chaibasa.

Project Work = 40 Marks

Written component = 40 Marks

Viva-voce = 20 Marks

Chemistry

Semester – IV

Core Course – 13

(Pharmaceuticals and Bio Organic)

Full Marks – 70

Time : 03 Hours

1. Eight questions are to be set at least one question from each chapter.
2. Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc 10 question of 1 mark each (Compulsory)
3. Any Four questions out of the remaining Seven questions to be answered 15 marks each.

I. Drug –

Introduction classification, drug absorption, metabolism & mode of action.

Synthesis & uses of

Sulpha drug – Sulpha pyridine, Sulpha diazine, Sulpha guanidine.

Antibiotic – Chloromycetin.

Antimalarial – Chloroquine, Plasmaquine.

Cardio Vascular drug – Sorbitrate

Anti tuberculous drug – P-amino salicylic acid (PAS), Thiacetazone, Ranitidine.

Anti-histamines or Antiallergic – Cetirizine,

Anti Aid/HIV- Zidovudine (AZT)

Anti-cancer – Cisplatin

(Bio-organic)

- | | |
|---|---------|
| II. Enzymes and Mechanism of Enzyme Action | 02 Hrs. |
| Basic considerations, Proximity effects and Molecular adaption. | |
| Enzymes | 03 Hrs. |
| Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. 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. | |
| Mechanism of Enzyme Action | 06 Hrs. |
| Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chymotrypsin, lysozyme and carboxypeptidase A. | |
| III. Kinds of Reactions Catalysed by Enzymes | 06 Hrs. |
| Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reaction. Enolic intermediates in isomerization reactions. P-cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation. | |

IV. Co-Enzyme Chemistry

04 Hrs.

Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes, Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, Lipole acid, vitamin B12, Mechanisms of reactions catalyzed by the above cofactors.

V. Biotechnological Applications of Enzymes

05 Hrs.

Large-scale production and purification of enzymes, techniques and methods of immobilization of enzymes effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in feed and drink industry-brewing and cheese-making, syrups from corn starch, enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, enzymes and recombinant DNA technology.

Book Suggested

1. Bio-organic Chemistry : A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer-Verlag.
2. Understanding Enzymes, Trevor Palmer, Prentice Hall.
3. Enzyme Chemistry : Impact and Application, Ed. Collin J. Suckling, Chapma and Hail.
4. Enzyme Mechanisms Ed. M.I Page and A. Villiams, Royal Society of Chemistry.
5. Fundamentals of Enzymology, N.C. Price and L. Slovens, Oxford University Press.
6. Immobilized Enzymes : An Introduction and Applications in Biotechnology, Michael O. Trevan, John Wiley.
7. Enzymatic Reaction Mechanisms, C. Walsh, W.H. Freeman.
8. Enzyme structure and Mechanism, A. Fersht, W.H. Freeman.
9. Bio-Chemistry : The Chemical Reactions of Living Cells, D.E. MeUler. Academic Press.
10. Introduction to Medicinal Chemistry- Gringuaz
11. Introduction to Medicinal Chemistry – Patrick G.L. Oxford University.

Sessional Internal Assessment (SIA) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry

Semester – IV

Core Course – 14

(Environmental Science and Green Chemistry)

Full Marks – 70

Time : 03 Hours

- Eight questions are to be set at least one question from each chapter.
- Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc 10 question of 1 mark each (Compulsory)
- Any Four questions out of the remaining Seven questions to be answered 15 marks each.

I. Environment 08 Hrs.
Introduction, Composition of atmosphere, vertical temperature, heat budget of the earth atmospheric system, vertical stability atmosphere, Biogeochemical cycles of C, N, P, S and O. bio distribution of elements.

II. Hydrosphere 12 Hrs.
Chemicals compositions of water bodies-lakes, streams, rivers, and wet lands etc. hydrological cycle, Aquatic Pollution – inorganic, organic, pesticide, agricultural, industrial and sewage, detergents, oil spills and oil pollutants. Water quality parameters – dissolved oxygen, biochemical oxygen demand (BOD), Solids, metals, content of chloride, sulphate, phosphate, nitrate and microorganism. Water quality standards, Analytical methods for measuring BOD, DO, COD, F, Oils, Metals (As, Cd, Cr, Hg, Pb, Se etc.). Residual chloride and chlorine demand. Purification and treatment water.

III. Atmosphere 08 Hrs.
Chemical composition of atmosphere-particles, ions and radical and their formation. Chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, O and their effect, pollution by chemicals, petroleum, minerals, chlorofluorocarbons (CFC's). Greenhouse effect, acid rain, air pollution controls and their chemistry. Analytical methods for measuring air pollutants. Continuous monitoring instruments.

IV. Soil 06 Hrs.
Composition, Micro & Macro, nutrients, pollution, fertilizer, pesticides, plastics and method, wash treatment.

V. Green Chemistry : Definition and Objective 10 Hrs.
The twelve principles of Green Chemistry, atom economy in chemical synthesis, important technique employed in practice of Green Chemistry, Application of microwave irradiation and ultrasound in chemical reactions. Use of renewable raw materials and biosynthesis, organic waste management, use of safer reagents and green solvents and green catalysts.

VI. Green Chemistry : Real Applications 10 Hrs.
Replacement of CFC and hydrocarbon blowing agents with environmental friendly blowing agent CO₂ in the production of polystyrene. Replacement of Ozone depleting and Smog producing solvents by surfactant assisted liquid or supercritical carbon dioxide for cleaning in manufacture of ICs and Computer chips.

Books Suggested

1. Environmental Chemistry and Green Chemistry, Asin Kr Das, Books and Allied (P) Ltd. Kolkata.
2. Environmental Chemistry, H. Kaur, Pragati Prakashan.
3. Environmental Chemistry, S.F. Manahan, Lewis Publishers
4. Environmental Chemistry, A.K. Dey, Wiley Easlem.
5. Environmental Chemistry, C. Baird, W.H. Freeman.

Sessional Internal Assessment (SIA) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry
M.Sc
Semester – IV
DSE – 3
(Inorganic Chemistry Special)

Full Marks – 70**Time : 03 Hours**

- Eight questions are to be set at least one question from each chapter.
- Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc 10 question of 1 mark each (Compulsory)
- Any Four questions out of the remaining Seven questions to be answered 15 marks each.

I. Metal storage transport and Biomineralization

5 Hrs

Cell membrane : Its structure and conformation properties of membranes, active and passive transport across biomembranes. The transport mechanism, transport of alkali and alkaline earth metals, ionophores, active transport of Na^+ and K^+ ions and nerve impulse, transport and storage of Iron (Transferrin & Ferritin). Transport of Iron in microorganisms (siderophores), types of siderophores (catecholate and Hydroxamate siderophores).

II. Calcium in biology

6 Hrs

Calcium in living cells, transport and regulation, binding sites of Ca^{2+} in proteins. Ca^{2+} in muscle contraction. Ca^{2+} in blood clotting process, selectivity of Ca^{2+} over Mg^{2+} in biochemical process.

III. Metalloenzymes

15 Hrs

Definitions : Apoenzyme, Coenzyme, Metalloenzyme, structure and functions of Zinc enzymes – carboxypeptidase and carbonic anhydrase A & B.
 Iron enzymes – catalase peroxidase and cytochrome P-450.
 Copper enzymes – super oxide dismutase.
 Molybdenum oxotransferase enzymes - xanthine oxidase.
 vitamin B_{12} & Coenzyme: structural feature, name of different forms, biochemical function of cobalmine.

IV. Metal-Nucleic Acid Interactions

6 Hrs

Structure of nucleic acid, Metal ions and metal complex interactions with nucleic acid, fundamental reaction with nucleic acid, application of nuclease activity of metal complexes, interaction in nature.

V. Metals in Medicine

5 Hrs

Metal ion toxicity: sources of toxicity, general aspect of mechanism of toxicity,
 Toxic effect of metals: Fe, Cu, As, Hg, Pb, Cd, Al-toxicity, metals as carcinogens.
 Introduction chelation therapy, some drugs used in metal ion detoxification. Limitation of chelation therapy, synthetic metal chelates as antimicrobial agents, antiarthritic gold drug chelation therapy, synthetic metal chelates as antimicrobial agents, antiarthritic gold drug, antitumor, anticancer drugs (Platinum complexes), Radioisotopes in medicines.

VI. Supramolecular Chemistry

15 Hrs

Concept and language

- Molecular recognition Molecular receptors for different type of molecular including arisonic substrates design and synthesis of coreceptor molecules and multiple recognition.
- Supramolecular reactivity and catalysis.
- Transport processes and carrier design.
- Supramolecular devices, supramolecular photochemistry, supramolecular electronic, ionic and switching devices.

Some example of self-assembly in supramolecular chemistry.

Book Suggested

1. Principles of Bioinorganic Chemistry, S.J. Lippard, J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.
3. Inorganic Biochemistry vol I and II, Ed. O.L. Eichhom, Elsevier.
4. Progress in Inorganic Chemistry, Vols 18 and 38 Ed. J.J. Lippard, Wiley.
5. Supramolecular Chemistry, J.M. Lehn, VCH.

Sessional Internal Assessment (SIA) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry
M.Sc.
 Semester – IV
DSE – 3
(Organic Chemistry Special)

Full Marks – 70**Time : 03 Hours**

- Eight questions are to be set at least one question from each chapter.
- Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc 10 question of 1 mark each (Compulsory)
- Any Four questions out of the remaining Seven questions to be answered 15 marks each.

I. Six – membered Heterocycles with one heteroatom 12 Hrs

Synthesis and reaction of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and pyridines.

Synthesis and reaction of quinolininium and their benzopyrylium salts, coumarins and chromones.

Six – membered heterocycles with Two or More Heteroatoms

Synthesis and reaction of diazines, tetrazines and thiazines.

II. Structure determination and synthesis of Vit. A, B₁, B₂, B₆, Vit. C and Vit. D. 12 Hrs**III. Steric and conformational properties** 6 Hrs

Various type of steric strain and their influence on reactivity steric acceleration molecular measurements of steric effects upon rates. Steric LFER. Conformational barrier to bond rotation spectroscopic detection of individual. Conformers acyclic and mono cyclic system rotation around partial double bonds Winstein Holness and Curtin. Hammett principle.

IV. Nucleophilic and electrophilic reactivity 6 Hrs

Structural and electronic effects on SN₁ and SN₂ reactivity solvent effect kinetic isotope effects inter molecular assistance electron transfer nature of SN₂ reaction. Nucleophilicity and SN₂ reaction based on curve, crossing model. Relationship between polar and electron transfer reaction. S_{RN1} mechanism. Electrophilic reactivity, general mechanism. Kinetic of S_{E2} – Ar reaction. Structural effects on rates and selectivity, Curve – crossing approach to electrophilic reactivity.

V. Supramolecular Chemistry 5 Hrs

Properties of covalent bonds – bond length, inter – bond angles, force constant, bond and molecular dipole moment. Molecular and bond polarizability, bond dissociation enthalpy, entropy. Intermolecular forces, hydrophobic effect, electrostatic, induction, dispersion and resonance energy, magnetic interactions, magnitude of interaction energy, forces between macroscopic bodies, medium effects, Hydrogen bond. Principle of molecular association and organization as exemplified in biological macromolecules like enzymes, nucleic acids.

VI. Rearrangement Reactions

Baeyer – Villiger rearrangement, Benzilic acid rearrangement, Favorskii rearrangement, Stevens rearrangement, Curtius rearrangement, Beckmann rearrangement, Benzidine rearrangement, Wittig rearrangement, Wagner – Meerwein Rearrangement.

Books Suggested

1. Molecular mechanics, U. Burkertand, N.L. Allinger, ACS Monograph 177, 1982.
2. Organic Chemists' book of OrbMals. L. Salem and W.L. Jorgensen, Academic press.
3. Mechanism and Theory in Organic Chemistry, T.H. Lowry and K.C. Richardson, Harper and Row.
4. Introduction theoretical Organic Chemistry and molecular. Modeling, W.B. Smith. VCH. Weinheim.
5. Supramolecular Chemistry; Concepts and perspectives, J.M. Lehn, VCH.
6. Heterocyclic Chemistry Vol. 1-3, R.R. Supta, M. Kumar and V. Gupta, Springer verlag.
7. The Chemistry of heterocycles, T. Eicher and S. Hauptmann, Theime.
8. Heterocyclic Chemistry, J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
9. Contemporary Heterocyclic Chemistry, Q.R. Newkome and W.W. Paudler, Wiley – Inter Science.
10. An introduction to the Heterocyclic compounds, Linds, R.M. Acheson, John Wiley.
11. Comprehensive Heterocyclic Chemistry, A.R. Kalriliky and C.W. Rees, eds. Pergamon press.
12. Natural prods; Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthirope and J.B. Harbome, Longman, Essex.
13. Organic Chemistry, Vol 2, I. L. Finar, ELBS.
14. Steroselective synthesis; a Practical Approach, Nogradi, VCH.
15. Chemistry Biological and Pharmacological Properties of Medicinal plants from the Americas. Ed. Kurt Hosieumann, M.P. Gupta and A. Marston. Harwood Academic Publishers.
16. New trends in natural product Chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.
17. Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers.
18. Introduction to Medicinal Chemistry – Gringuaz
19. Introduction to Medicinal Chemistry - Patrick G.L. Oxford University

Sessional Internal Assessment (SIA) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry
M.Sc.
Semester – IV
DSE – 3
(Physical Chemistry Special)

Full Marks – 70

Time : 03 Hours

1. Eight questions are to be set at least one question from each chapter.
2. Question 1 will be objective type question (MCQ)/True-False/Fill in the blanks etc. 10 question of 1 mark each (Compulsory)
3. Any Four questions out of the remaining Seven questions to be answered 15 marks each.

I. Potential Energy Surfaces

Mechanism of activation, Potential Energy Surface for three atom reaction. Potential Energy curve for successive reaction, proportions of Potential Energy Surfaces. Inter conversion of translational and vibrational energies, combination of atoms, orthopara conversion. Activated state of three atom and four atom reaction, Potential Energy refile, reaction co-ordinate. Transmission co-efficient.

II. Kinetics of Condensed Phase Reactions

Rate determining steps in diffusion controlled reactions and activation controlled reactions, Stokes Einstein equation and dependence of rate constant on co-efficient of viscosity of medium, Kinetics of ionic reactions in solution-electrostatic contribution to free energy in single and double spherical models of activated complex, entropy of activation for ion-ion reaction; Kinetics of dipole-dipole reaction, ion-dipole reaction, dependence of rate constant on ionic strength and dielectric constant of medium, Bronsted Bjerrum equation.

III. Catalysis and Oscillation

Kinetics of catalytic reactions, theory of acid-base catalysis, Van't Hoff and Arrhenius complexes. Protogenic and Protophilic mechanisms. Effect of salt on acid-base catalysis, autocatalysis, non-competitive and competitive inhibitors, Bronsted catalysis law, rate of reaction and acidity function. Liner free energy relationship, Hammett equation. Meaning of substituent constant and reaction constant in organic reactions. Reactions in Biological system. Oscillating reaction, Lotka-Volterra model. B-Z reaction.

IV. Study of Fast Reaction

Photo Physical Chemistry – Flash Photolysis. Relaxation technique, Nuclear Magnetic Resonance Method. Molecular beam and Shock – tube Kinetics, flow method. Reactions of Protons, Electrons metal ions.

V. Electrodes Kinetics

Faradaic and non-faradaic current, Rate law in faradaic process, Current density, Factors affecting electrode reaction Types of over voltage, Polarisation, Polarisation curves, Electric Potential. Derivation of Nernst equation (i) On thermodynamic consideration and (ii) by Kinetic approach Tafel plot. Butte-Volmer equation, Nernst diffusion layer treatment, exchange current density, Stoichiometric number, Conce of rate determining steps. Energy Barriers for multi steps reactions.

VI. Electrode Deposition and Corrosion Processes

Eletrocatalysis – electrocalaytic rate, Eletrocatalysis in redox system. Total deposition current density, Time variation of the over potential and rate determining step in electrode deposition total over potential for electrode deposition at steady state. Hydrogen over voltage, rate determining stop of the hydrogen evolution reaction, determination of reaction order with respect to H^+ ion in solution. Corrosion current. Elctro nation current and Corrosion potential, electro nation reaction, corrosion and stability of metals.

Sessional Internal Assessment (SIA) Full Marks – 30 Marks

A – Internal written Examination – 20 Marks (1 Hr)

B – Written Assignment – 05 Marks

C – Over All Performance including Regularity – 05 Marks

Pass Marks = 17

Chemistry

M.Sc.

Semester – IV

DSE – 4 (Practical)

(Inorganic Chemistry Special)

Full Marks – 100

Time : 06 Hours

Two questions are to be set

I. Preparation of inorganic complexes, their purification, Molecular Weight determination and elucidation of the structures by available physical methods.

- (a) Preparation and characterization of Cr (III) complexes
 - (i) $[\text{Cr}(\text{H}_2\text{O})_6]\text{NO}\cdot\text{H}_2\text{O}$
 - (ii) $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl}\cdot\text{H}_2\text{O}$
 - (iii) $\text{Cr}(\text{acac})_3$
- (b) (i) Purification of inorganic complexes using techniques such as crystallization, Volatilisation etc.
(ii) Tests for purity – M.P. TLC, Metal analysis etc.
- (c) Preparation and study of cis and trans isomers of bis (glycinato) copper (II)
 - (a) Cis – (glycinato) Cu (II) monohydrate
 - (b) Trans-(glycinato) Cu (II) monohydrate (IR Spectroscopy)
 - (c) Preparation of mercury tetrathiocyanato cobaltate : $\text{Hg} [\text{Co}(\text{CNS})_4]$

II. Flame photometric determination

- (a) Sodium and Potassium when present together
- (b) Li / Ca / Ba / Sr

III. Naphelometric determinations

- (a) Sulphate
- (b) Phosphate
- (c) Silver

IV. Determination of

- (a) Manganese / Chromium / Vanadium in steel sample by spectrophotometric method.
- (b) Ni / Mo/ W/ V/ U by extractive spectrophotometric method.

Experiments – 80 Marks

Viva-Voice – 10 Marks

Notebook – 10 Marks

Chemistry

M.Sc.

Semester – IV

DSE – 4 (Practical)

(Organic Chemistry Special)

Full Marks – 100

Time : 06 Hours

Two questions are to be set

I. Quantitative Analysis

Some illustrative exercises are given below :

1. Estimation of phenol / aniline using bromate bromide solution / or acetylation method.
2. Estimation of carbonyl group by using 2, 4-dinitrophenyl hydrazine.
3. To estimate nitrogen in the given sample by Kjeldahl method.
4. To estimate sulphur in the given sample by the $\text{Na}_2\text{CO}_3\text{-KNO}_3$ fusion method.
5. To estimate sulphur in the given sample by Messenger's method.
6. To estimate halogen in the given sample by the alkaline reduction method (modified stepanow method).
7. To determine the percentage or number of hydroxyl group in the given sample by the acetylation method.
8. To determine the percentage or number of phenolic groups in the given sample by the acetylation method.
9. To determine the percentage or number of phenolic groups in the given sample by the Zeisel's method.
10. To determine the iodine number of the given fat or oil sample.
11. Synthesis of chalcones using benzaldehyde and acetophenone.
12. Synthesis of coumarin using phenol and ethylacetoacetone.

II. Characterization of organic compounds. The student is expected to carry out analysis of components of binary organic mixture (liquid-liquid, liquid-solid, solid-solid). Using chemical analysis and IR and PMR data. The students should also to check the purity of the separated components on TLC plates.

Experiments – 80 Marks

Viva-Voice – 10 Marks

Notebook – 10 Marks

Chemistry
M.Sc.
Semester – IV
DSE – 4 (Practical)
(Physical Chemistry Special)

Full Marks – 100

Time : 06 Hours

Two questions are to be set

I. Chemical Kinetics

- (a) To study the kinetics of alkaline hydrolysis of an ester in aqua-organic solvent system with respect to effect the solvent composition and dielectric constant on rate constant.
- (b) To determine the rate constant of the reaction between $K_2S_2O_8$ and KI at two different temperature and hence to determine the energy of activation of the reaction.

II. Thermochemistry

- (a) Determination of basicity of polybasic acid.
- (b) Determination of heat of displacement of Cu by Zn and Cu^{+2} salt solution.
- (c) Determination of heat of hydration of Na_2SO_4 to $Na_2SO_4 \cdot 10H_2O$.

III. Distribution Law

Determination of equilibrium constant for the reaction $KI + I_2 = KI_3$.

IV. Thermodynamics and Surface Chemistry

- (a) To study the adsorption of acetic acid on charcoal.
- (b) To determine the partial molar volume of solutions of simple salts and to study its variation with concentration.

V. Viscosity and Surface Tension

- (a) To determine the radius of a molecule from viscosity measurement.
- (b) To determine the parachor of $-CH_2$, C and H.

Experiments – 80 Marks

Viva-Voice – 10 Marks

Notebook – 10 Marks

Chemistry

M.Sc.

Semester – IV

Project Work (End Sem.)

Full Marks – 100

The paper will consist of

- (a) Final submission of dissertation.
- (b) Presentation of project work in the seminar and open viva-voce.

Each student has to submit three copies of the dissertation work duly forwarded by HOD of Department / Principal of the college. The forwarded copies will be submitted to the Department of Chemistry, Kolhan University, Chaibasa. (Seven days before the seminar)

NB : The seminar will be held in the Department of Chemistry, Kolhan University, Chaibasa.

Written component = 80 Marks

Viva-voce = 20 Marks