EXAMINATION SCHEME

M.Sc. examination will be conducted in four SEMESTERS. Each semester exam shall consist of FOUR THEORY PAPERS AND TWO LAB COURSES.

SEMESTER-I (20 CREDIT)

THEORY (16 CREDIT)

PAPER	COURSE	CREDIT	DURATION	INTERNAL ASSESSMENT	THEORY MARKS	TOTAL MARKS
CH-1	Inorganic Chemistry	4	3 Hrs	20	80	100
CH-2	Organic Chemistry	4	3 Hrs	20	80	100
CH-3	Physical Chemistry	4	3 Hrs	20	80	100
CH-4	Spectroscopy- I and Group Theory	4	3 Hrs	20	80	100

PRACTICAL (4 CREDIT)

PAPER	COURSE	CREDIT	DURATION	MARKS
CH-5	Lab Course-I	2	8Hrs	100
CH-6	Lab Course-II	2	8Hrs	100

SEMESTER-II (20 CREDIT)

THEORY (16 CREDIT)

PAPER	COURSE	CREDIT	DURATION	INTERNAL ASSESSMENT	THEORY MARKS	TOTAL MARKS
CH-7	Coordinating Chemistry	4	3 Hrs	20	80	100
CH-8	Organic Chemistry	4	3 Hrs	20	80	100
CH-9	Physical Chemistry	4	3 Hrs	20	80	100
CH-10	Theory and applications of spectroscopy-II	4	3 Hrs	20	80	100

PRACTICAL (4 CREDIT)

PAPER	COURSE	CREDIT	DURATION	MARKS
CH-11	Lab Course-III	2	8Hrs	100
CH-12	Lab Course-IV	2	8Hrs	100

M.Sc. CHEMISTRY SEMESTER –I

CH-1

Paper-I

INORGANIC CHEMISTRY 68Hrs

Unit-I

Stereochemistry and Bonding in Main Group Compounds 8Hrs

VSEPR theory, Walsh diagram (tri - and penta - atomic molecules), dπ - pπ bond, Bent rule and energetics of hybridization.

Metal - Ligand bonding 10Hrs

Limitation of crystal field theory, molecular orbital theory (MOT), MOT for octahedral, tetrahedral and square planar complexes, π-bonding and molecular orbital theory.

Unit-II

(A) Metal-Ligand Equilibrium in Solution 8Hrs

Stepwise and overall formation constants; trends in stepwise constant, 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 formation constants by:

(1) Spectrophotometric Method (Jobs and mole ratio method)

(2) Potentiometric Method (Irving –Rossotti Method)

(B) Isopoly and Heteroply acids and salts of Mo and W- Preparation, properties and structures. **4Hrs**

Unit-III

Reaction Mechanism of Transition Metal Complexes-I 15Hrs

Energy profile of a reaction, reactivity of metal complex, 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 reaction, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anion reactions, reactions without metal ligand bond cleavage.

Unit-IV

(A) Metal Clusters:- Higher boranes, wade's rule (PSEPT) carboranes, 15Hrs

Metalloboranes and metallocarbornes, metal carbony1 and halide cluster, compounds with metal-metal multiple bonds.

(B) Rings:- Borazine & Phosphazenes

Seminar: 8Hrs

Book Suggested

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes and Row.
3. Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon.
4. Comprehensive Coordination Chemistry, Keemtilal and Other, Pragati Prakashan.
5. Selected topic in Inorganic Chemistry, W.U. Walik, G.D. Tuli and R.D. Madan, S. Chand Publishing.
6. Mechanism of Inorganic Reactions, Fred Basalo and Ralph G> Pearson, Wiley Eastern Pvt. Ltd.
7. Co-ordination Chemistry, S.S. Rao and Vani Rao, Kalyani Publisher.

M.Sc. CHEMISTRY SEMESTER –I

CH-2

Paper-II

ORGANIC CHEMISTRY 68Hrs

Unit-I

A. Nature of Bonding in Organic Molecules 10Hrs

Delocalized chemical bonding, conjugation, cross conjugation, resonance hyperconjugation, bonding in fullerences, tautomerism.

Aromaticity in benzenoid and non-benzoid compounds, alternate and non-alternate hydrocarbons. Huckel's rule, energy level of π-molecular orbitals, annulenes, homo-aromaticity, homo-aromaticity, PMO approach

B. Molecular Rearrangement 8Hrs

General mechanistic approach to molecular rearrangement reactions, carbocation rearrangement-migratory aptitude and memory offects.

Brief study of following rearranh=gement reactions. Favoroskii, Baeyer-Villigers oxidation, Stock enamine reaction, Shapiro reaction, Sommelet rearrangement, wittig's rearrangement, Grovenstein-Zimmerman rearrangement.

. **Unit-II**

A. Reaction Mechanism: Structure and Reactivity 10 Hrs

Type of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotopes effects. Hammett equation and linear free energy relationship, substituent and reaction constants.

B. Reaction Intermediates

Generation, structure, stability and reactivity of carbocations,free radicals, carbenes nitrenes and benzynes. Application of NMR in detection of carbocations.

Unit-III

A. Pericyelic Reactions 5 Hrs

Molecular orbital symmetry, frontier orbitals of ethylene, 1,3 butadiene, 1,3, 5- hexatriene and allyl system. Classification of pericyclic reactions. Wood ward-Hoffmann correlatino diagrams. FMO and PMO approach. Electrocyclic reactions, conrotatory and disrotatory motions, 4n 4n+2 and allyl systems.

Cycloadditions - antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cyclo additions and cheleotropic reactions. Sigmatropic rearrangements -suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3 and 5,5 - sigmatropic rearrangements. Claisen, Cope and Aza-Cope rearrangements. Fluxional tautomerism, Ene reaction.

Unit-IV **14Hrs**

Stereochemistry

Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric Strain due to unavoidable crowding Elements of symmetry, chirality, molecules with more than one chiral center, threo and ertythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereo selective synthesis, Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spirane), chirallity due to helical shape. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.

Seminar: **8Hrs**

Books 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. Structures 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 Reactions- H. O. House, Benzamic.
7. Principles of Organic Synthesis- R. P. C. Norman and J. M. Coxon, Blackie Academic and Professional.
8. Pericyclic Reactions- S. M. Mukherji.
9. Reaction Mechanism in Organic Chemistry- S. M. Mukherji and S. P. Singh, Macmilan.
10. Stereochemistry of Organic Compounds- D. Nasipuri, New Age International.
11. Stereochemistry of Organic Compounds- P.S. Kalsi, New Age International.

M.Sc. CHEMISTRY SEMESTER –I

CH-3

Paper-III

PHYSICAL CHEMISTRY **68Hrs**

Unit-I **15 hrs**

A. Quantum Chemistry

Introduction to exact quantum mechanical results. The Schrodinger equation and the postulates of quantum mechanics. Applications of Schrodinger equation to particle in 1- dimensional box, 3 dimensional box, harmonic oscillator and hydrogen atom.

B. Approximate Methods

The variation theorem, Perturbation theory, application of variation and perturbation theory to hydrogen atom.

Unit-II **15 hrs**

A. Thermodynamic

Classical Thermodynamics :- Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar Properties free energy, partial molar volume and partial molar heat content and their significance. Determinations of these quantities. Concept of fugacity and determination of fugacity.

B. Non-Ideal systems

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

Unit-III **12 hrs**

A. Chemical Dynamics

Methods of determiningorder of reaction, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory, kinetic salt effects, steady state kinetics, and thermodynamic control of reactions, treatment of unimolecular reactions. Dynamic chain (hydrogen-bromine raction, decomposition of acetaldehyde & ethane), Photo chemical chain reaction (hydrogen- Bromine and hydrogen-chlorine reactions).

Unit-IV

A. Surface Chemistry **8Hrs.**

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 of surfaces.

B. Electrochemistry **10Hrs.**

Theory of strong electrolyte:- Debye- Huckel theory, Test of Debye Huckel theory, Extension of Debye Huckel equation, Derivation of Onsager equation, Validity of Onsager equation, Deviation from Onsager equation.

Seminar- **8Hrs.**

Book Suggested:

1. Physical Chemistry- P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistry- A.K. Chandra, Tata Mc Graw Hill.
3. Quantum Chemistry- Ira N. Levine, Prentice Hall.
4. Chemical Kinetics- K. J. Laidler, Pearson.
5. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose, McMillan.
6. Modern Electrochemistry Vol. I and 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.

M.Sc. CHEMISTRY SEMESTER –I

CH-4

Paper-IV

SPECTROSCOPY-I AND GROUP THEORY 68Hrs

Unit-I 15 hrs

Unifying Principles

Electromagnetic radiation, interaction of electromagnetic radiation with matter- absorption, emission transmission, reflection, dispersion, polarization and scattering, Uncertainty relation and natural line width and natural line broadening, transition probability, selection rules, intensity of spectral lines, Born-Oppenheimer approximation, rotational, vibrational and electronic energy levels. Region of spectrum, representation of spectra, F.T. spectroscopy, computer averaging, lasers.

Unit-II 15 hrs

Microwave Spectroscopy

Classification of molecules in term of their internal rotation mechanism, determination of rotation energy of diatomic and polyatomic molecules, intensities of rotational spectral lined, effect of isotopic substitution on diatomic and polyatomic molecules, intensities of rotational spectral lines and parameters of rotational energy of linear and the transition frequencies, non-rigid rotators, spectral lines and parameters of rotational energy of linear and symmetric top polyatomic molecules. Application in determination of bond length.

Unit-III 15 hrs

A. Vibrational Spectroscopy: Infrared Spectroscopy

Review of linear harmonic oscillator, operational energies of diatomic molecules, Zero point energy, force constant and bond strengths anhormonicity, Morse Potential Energy Diagram, vibrational, rotation spectroscopy. P.Q.R. branches. Breakdown of Oppenheimer approximation. Vibration of poly atomic molecules. Selection rules, normal modes of vibration, group frequencies overtones hot bands factors affecting the band positions and intensities for iR region.

B. Raman Spectroscopy

Classical and quantum theories of Raman effect, pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules mutual exclusion principles. Resonance Raman spectroscopy, Coherent anti Stokes Raman spectroscopy (CARS).

Unit-IV 15 hrs

Symmetry & Group Theory

Symmetry elements & symmetry operations definition of group, sub-group relation between orders of finite group & its sub-group, conjugacy relation and classes, point symmetry group Shonflies symbols, representation of group by metrices (representation for the Cn, Cnh, Cnv, Dnh etc. group to oe worked out explicitly) Character tables & their use.

Books Suggested:

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Applied Electron Spectroscopy for chemical analysis Ed. H. Windawi and Wiley Interscience.
3. Spectroscopy, H. Kaur, Pragati Prakashan.
4. Molecular Spectroscopy, Banwell, Tata Mc Graw-Hill.
5. Introduction to Photoelectron Spectroscopy, P.K. Ghose, John Wiley.
6. Molecular Spectroscopy, P.S. Sindhu, New Age International.
7. An Introduction to Spectroscopy, S.S. Kalra, Anusandhan Prakashan.
8. Group Theory by Cotton.
9. Group Theory, Bhattacharya, Goel Publisher.
10. Molecular symmetry and its application, Shukla and Kumar Anushandhan Prakashan.
11. Symmetry and Spectroscopy of molecules, K. Veera Reddy, New Age International.

M.Sc. CHEMISTRY SEMESTER –I

CH-5

LABORATORY COURSE -01

Inorganic Chemistry **MM 100**

TIME: 10Hrs.

1. Quantitative analysis

Separation and determination of two metal ions from solution mixtures. One by Volumetric and other by Gravimetric methods Cu-Ni, Ni-Zn, Cu-Fe etc.

2. **Preparation of selected inorganic compounds.**

1. Cis-K [Cr(C2O4)2 (H2O)2]
2. Mn (acac)3
3. K_2 [Fe (C2 O4)3]
4. Prussian Blue, Turnbull's Blue.
5. [Ni $(NH_3)_6$] Cl_2
6. [Ni $(dmg)_2$]
7. [Cu $(NH_3)_4$] SO_4. H_2O

3. Qualitative analysis of mixture containing 08 radicals including two less common metal ions by semi micro method.

Basic Radicals: Ag^{I}, Pb^{II} Bi^{III}, Cu^{II}, Cd^{II}, As^{III}, Sb^{III}, Sn^{II}, Fe^{III}, $A1^{III}$, Cr^{III}, Zn^{II}, Mn^{II}, Co^{II}, Ni^{II}, Ba^{II}, Ca^{II}, Mg^{II}, Na^{I}, K^{I}, Ce^{IV}, Zr^{IV}, W^{IV}, Te^{VI}, Til, Mo^{IV}, U^{VI}, V^{V}, Be^{II}, Li^{I}, Au^{I}, Pt^{IV},

Acid Radicals: Carbonate, suiphide, sulphate , nitrite, nitrate, acetate, chloride, fluoride, Bromide, iodide, borate,sulphonate, oxalate, phosphate, silicate, thiosulphate, Ferrocyanide, ferricyanide, sulphocyanide, chromate, arsenate and permanganate.

4. Estimation

1. Phosphoric acid in commercial ortho-phosphoric acid.

2. Boric acid in borax.

3. Ammonia in ammonium salt.

4. Manganese dioxide in pyrolusite.

5. Available chlorine in bleaching powder.

6. Hydrogen per oxide commercial sample.

Note:- Two exercise will be given to students in the practical examination of 10Hrs duration

Books Suggested:

1.Vogel's Text Book of Qualitative Analysis, revised, J. Bassett, R. C. Denney, G.H. Jeffery and J. Mendham, ELBS.

2. Synthesis and Characterisation of Inorganic Compounds, W.L. Jolly, Practice Hall.

SCHEME FOR PRACTICAL EXAMINATION

EXPERIMENT	**MARKS**
Experiment-1	30
Experiment-2	30
Viva-voce	20
Sessional Marks	20
TOTAL MARKS	100

M.Sc. CHEMISTRY SEMESTER –I

CH-6

LABORATORY COURSE -02

Physical Chemistry Practical **MM 100**

Time -06 Hrs.

1. Adsorption

- **a)** To verify the freundlich and Longmuir isotherms for adsorption of acetic acid on activated charcoal.
- **b)** To study adsorption of oxalic acid on charcoal using $KMn0_4$.
- **c)** To study adsorption of picric acid on charcoal by colorimeter.

2. Polarimetry

- **a)** Study the kinetics of hydrolysis of cane sugar.
- **b)** Determination of catalytic coefficient of hydronium ion catalyst (Inversion of sugar at low acid concentration).
- **c)** Determination of specific rotation of glucose and fructose solution.
- **d)** Determination of velocity constant of the inversion of sugar by mono, di and trichloro acetic acid.

3. Chemical Kinetics

- **a)** Determination of the effect of temperature, Change of concentration of reactants and catalyst and ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions.
- **b)** Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
- **c)** Determination of the rate constant of oxidation of iodide ions by hydrogen peroxide by studying the Kinetics as an iodine clock reaction.

4. Solutions

- **a)** To determine the critical micelle concentration of a soap (Sodium Laurate, Sodium palmilate etc.) by surface tension measurements.
- **b)** To compare cleaning powders of two sample of detergent.
- **c)** Determine the critical solution temperature of phenol and water in presence of (I) 1.0% sodium chloride (II) 0.50% naphthalene (III) 1.0% Succinic acid.

5. Electrochemistry-

a.) Conductometry

1. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by NaOH conductometrically.
2. Determination of solubility and solubility product of sparingly soluble salts (PbSO4, BaSO4) conductometrically.
3. Determination of strong and weak acids in agiven mixture conductometrically.
4. Determination of the activity coefficient of HCI at different concentrations using Debye-Huckel's law.

b.) Potentiometry/ pH metry

1. Determination of the strength of strong and weak acids in a given mixture using potentiometer/pH meter.
2. Determination of temperature/ pH meter.
3. Acid base titration in aqueous media using a pH meter.
4. Determination of activity and activity coefficient of electrolytes.
5. Determination of dissociation constant of mono-basic/di-basic acid.
6. Construct the calibration curve (pH-E_{obs}) for quinhydrone electrode, and hence determine the standard oxidation potential of the quinhydrone electrode.

Reference Books:

1. Advance Practical Physical Chemistry- Dr. J. B. Yadav Krishna Prakashan Media(P) Ltd, Merut.
2. Senior Practical Physical Chemistry Dr. B.D. Khosla, V. C. Gars Adarsh Gutani- R. Chand & W. New Delhi.
3. Experiments in Physical Chemistry by Dr. J. C. Ghose-Bharati Bhawan.
4. Findley's Practical Physical Chemistry, B. P. Levi.
5. Hand Book of Organic Analysis-Qualitative and Quantitative, H. Clark Adward Arnold.
6. Practical Physical Chemistry, A. M. James and F. E. Prichard, Longman.

SCHEME FOR PRACTICAL EXAMINATION

EXPERIMENT	MARKS
Experiment-1	30
Experiment-2	30
Viva-voce	20
Sessional Marks	20
TOTAL MARKS	**100**

M.Sc. CHEMISTRY SEMESTER-II
CH-7, PAPER-I
COORDINATION CHEMISTRY

68 Hrs.

Unit – I

Reaction Mechanism of Transition Metal Complexes II: Kinetics and mechanism of ligand substitution reaction in square planner complexes, factors affecting the mechanism of square planner complexes. The Trans effect: theories and applications. Kinetics of ligand substitution reaction in tetrahedral complexes. Redox reactions, electron transfer reaction, Marcus theory, simplified Marcus equation, excited state outer sphere electron transfer reaction, cross reaction, inner sphere reactions; types, mechanism of electron transfer in inner sphere reaction, mechanism of two electron transfer.

Unit – II **15 Hrs.**

Electronic Spectra of Transition Metal Complexes: Determination of spectroscopic ground states, Hunds rule, term symbols for excited states, microstates and derivation of Russell – Saunders terms, Selection rule for electronic spectroscopy, correlation, orgel and Tanabe – Sugano diagrams for transition metal complexes (d_1 – d^9 states). Nephetauxetic effect, Calculations of Dq and B and B' parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information.

Unit – III **15 Hrs.**

Magnetic Properties of Transition Metal Complexes: Elementary theory of magneto chemistry, Gouy's methos determination of magnetic susceptibility, Calculation of magnetic moment, magnetic properties of complexes of various geometries based on crystal field model, spin free and spin paired equilibria, Orbital contribution to magnetic moments, magnetic exchange coupling and spin crossover.

Unit – IV **15 Hrs.**

Metal π Complexes: Metal carbonyl, 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 phosphine as ligand.

Books Suggested

1. Advanced Inorganic Chemistry, F.A. Cotton John Wieley.
2. Inorganic Chemistry, J.E. Huheey Harper & Row.
3. Co-ordination Chemistry, D. Banerjee, Asian Books PVT. LTD.
4. Magneto Chemistry, Shyamal Dutta.
5. Co-ordination Chemistry, S.S. Rao and Vani Rao, Kalyani Publishers
6. Advanced Inorganic Chemistry, Keemti Lai and Agrawal, Pragati prakashan.
7. Inorganic Chemistry Part I & Part II, Rashmi Jain, Usha Soni, Pragati prakashan.

M.Sc. CHEMISTRY SEMESTER-II
CH-8, PAPER-II
ORGANIC CHEMISTRY

68 Hrs.

Unit – I **14Hrs.**

A. Electrophilic substitution reactions:
Aliphatic electrophilic substitution- Biomoleculer mechanism: SE^2, SE^1 and SE^1 mechanism, electrophilic substitution accompanied by double bond shift, effect of substrates, leaving group and the solvent polarity on the reactivity.

B. 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 substrated and electrophiles, Diazonium coupling, Gattermann Koch reaction, Vilsmeir reaction.

Unit – II **14Hrs**

A. Nucleophilic Substitution reactions:
Aliphatic nucleophilic substitution: The S_N^2, S_N^1, mixed S_N^1 and S_N^2 and SET mechanism. The neighbouring group mechanism, neighbouring group participation by π and σ bonds. The S_N^1 mechanism Nucleophilic substitution at an allylic aliphatic trigonal and at a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, ambident nucleophile.

B. Aromatic Nucleophilic substitution: The S_NAr, S_N^1, benzyne and S_N^1 mechanism, Reactivity-effect of substrate structure. Leaving group and attacking nucleophile. The Von Richter, Sommelet-Hauser and Smiles rearrangement.

Unit – III

A. Free Radical reactions **(10+8)Hrs.**

Type of free radical reactions, Free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance.

Reactivity for aliphatic and aromatic substrates at a bridge head. Reactivity in the attacking radicals. The effect of solvents on reactivity. Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction. Free radical rearrangement, Hunsdiecker reaction.

B. Addition to Carbon-Carbon Multiple Bonds **8Hrs.**

Mechanism and stereo chemical aspects of addition reactions involving electrophiles, Necleophilics and Free radicals, region and chemoselectivity. Orientation and reactivity, Addition to cyclopropane ring. Hydroborations Michael reaction, epoxidation.

Unit – IV

A. Addition to Carbon-Hetero multiple bonds: **9Hrs.**

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters nitriles. Addition of Grignard's reagents, organozine and organolithium reagents to carbonyl and unsaturated carbonyl compounds, mechanism of condensation reactions involving enolates – Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perking and Stobbe reactions, Hydrolysis of ester and amides, Ammonolysis of esters.

B. Elimination reaction: **5Hrs.**

The E_2, E_1 and $E1_{CB}$ mechanisms and their spectrum. Orientation of the double bond. Reactitivty-effects of substrate structures, attacking base, the leavign group and the medium. Mechanism and orientation in pyrolytic elimination.

Seminar -

Book Suggested

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.K. Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Comell University Press.
5. Organic Chemistry, R.T. Morrison and R.N. Boyed, Prentice-Hall.
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.P.C. Norman and J.M. Coxon, Blackie Academic and Professional.
8. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.

M.Sc. CHEMISTRY SEMESTER-II
CH-9, PAPER-III
PHYSICAL CHEMISTRY

68 Hrs.

Unit – I

15Hrs.

A. Quantum Chemistry – Angular Momentum: Ordinary angular momentum, generalized angular momentum, eigen functions for angular momentum, eigen values of angular momentum.

B. Electronic Structure of Atoms: Electronic configuration, Russell Saunders term and coupling schemes, term separation energies of P^n & d^n configurations, magnetic effects:- spin orbit coupling and Zeeman splitting.

Unit – II

15Hrs.

A. Statistical Thermodynamics:

1. Probability theorem in statistical thermodynamics. System Assembly and Ensemble. Statistical equilibrium, Thermodynamic equilibrium.
2. Partition function – Translational, rotational, vibrational and electronic partition function, calculation of themodynamic properties in terms of partition function. Application of partition functions.

B. Non Equilibrium Thermodynamics: Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entroy balance equations for different irreversible processes (e.g. heat flow, chemical reaction) transformations of the generalized fluxes and forces, non equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsager's reciprocity relations.

Unit – III

8Hrs.

A. Chemical Dynamics:

Homogenous catalysis, kinetics of enzyme reactions (Michalis Kinetics), study of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method, Dynamics of unimolecular reactiosn (Lindemann - Hinshelwood and Rice – Ramsperger - Kassel- theories).

B. Surface Chemistry:

a) **Micelles:** Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solublization, micro emulsion, reverse micelles.

Unit – IV

5Hrs.

A. Macromolecules: Polymer-definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, number and mass average, molecular mass, molecular mass determination (Osmometry, viscometry, diffusion and light scattering methods), sedimentation, chain configuration of macromolecules.

B. Electrochemistry:

1. Polarisation and decomposition potential – Demonstration of polarization, Elimination of polarization decomposition potential, decomposition potential of aqueous solution and neutral solution.

2. Over Voltage: Hydrogen over voltage – its measurement, oxygen over voltage, Determination of factors affection over voltage, importance of over voltage.

Seminar -

Books Suggested :-

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata Mc Graw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4.Chemical Kinetics. K.J. Laidler, McGraw-Hill.
5. Kineties and Mechanism of Chemical Transformation J.Rajaraman and J. Kuriacose, Mc Millan.
6. Modern Electrochemistry Vol. 1 and Vol II J.O.M. Bockris and A.K.N. Reddy, Planum.
7. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.

M.Sc. CHEMISTRY SEMESTER-II
CH-10, PAPER-IV
THEORY & APPLICATION OF SPECTROSCOPY - II

68 Hrs.

Unit – I

15Hrs.

Nuclear Magnetic Resonance Spectroscopy: Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift, deshielding, spin-spin interactions, factors influencing coupling constant "j" Classification (ABX, AMX, ABC, A_2B_2 etc.). Spin decoupling; basic ideas about instrument, NMR studies of nuclei other than proton-^{13}C, ^{19}F and ^{31}P FT-NMR, advantages of FT-NMR use of NMR in medical diagnostics.

Unit – II

15Hrs.

A. X-ray Diffraction: 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 diffraction pattern, Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem. Description of the procedure for an X-ray structure analysis, absolute configuration of molecules, Ramchandran diagram.

B. Electron Diffraction: Scattering intensity Vs scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules. Low energy electron diffraction and structure of surfaces.

C. Neutron Diffraction: Scattering of neutrons by solids and liquids, magnetic scattering, measurement techniques, Elucidation of structure of magnetically ordered unit cells.

Unit – III

15Hrs.

A. Electron Spin Resonance Spectroscopy: Basic principles 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.

B. Nuclear Quadrupole Resonance Spectroscopy: Quadrupole nuclei, Quadrupole moments, electronic field gradient, coupling constant, splitting, Applications.

Unit – IV

15Hrs.

Mass Spectrometry: Introduction, basic principles, separation of the ions in the analyzer, resolution, molecular ion peak, mass spectral fragmentation of organic compounds, factors affecting fragmentation, McLafferty rearrangement. Instrumentation, Characteristics of mass spectra of Alkanes, Alkenes, Aromatic hydrocarbons. Alcohols, Amines, Nitrogen rule, ring rule, Molecular weight and formula determination, Gas chromatography-Mass spectrophotometry: Introduction.

Seminar - **8Hrs.**

Books Suggested :-

1. Modern Spectroscopy, J.M. Hollas, John Viley.
2. Fundamental of Molecular Spectroscopy, C. N. Banwell.
3. Spectroscopy,B.K. Sharma, Goel Publication.
4. Orgamic Spectroscopy: Principles and Application, Jag Mohan, Narosa Publication.
5. Spectroscopic Methods in Organic Chemistry, D.H. Williams * I. Fleming, Tata Mcgraw-Hill Publication.
6. Spectrophometric Identification of Organic Compounds, R.M. Silverstein & F.X. Webster, John Wiley Publications.

M.Sc. CHEMISTRY SEMESTER-II
CH-11
LABORATORY COURSE – 03
Organic Chemistry

MM 100
TIME: 6 Hrs.

1. **General Methods for Separation and Purification of Organic Compounds with Special reference to:**
   - Solvent Extraction
   - Fractional Crystallizations
2. **Distillation Techniques:**
   Simple distillation, steam distillation, Fractional distillation and Distillation under reduced pressure.
3. **Analysis of Organic Binary Mixture:**
   Separation and identification of organic binary mixtures containing two components.(A student is expected to analyze at least 10 different bina mixtures)
4. **Preparation of Organic Compounds: Single Step Preparation:**
   - **I.** Acetylation: synthesis of (β – Naphthyl acetate from β – Naphtol Diacetate from Hydroquinone.
   - **II.** Aldol condensation: Dibenzal acetone from benzaldehyde.
   - **III.** Bromination: p-bromoacetanilide from acetanilide.
   - **IV.** Canizzaro reaction: Benzoic acid and benzyl alcohol from benzaldehyde.
   - **V.** Friedel crafts reaction: O-benzoyl benzoic acid from phthalic anhydride.
   - **VI.** Grignard reaction: Synthesis of triphenylmethanol from benzoic acid.
   - **VII.** Oxidation: Adipic acid by chromic acid oxidation of cyclo-hexanol.
   - **VIII.** Perkin's reaction: Cinnamic acid from benzaldehyde.
   - **IX.** Sandmeyer reaction: p-chlorotoluene formp-toluidine/O-chlorobenzoic acid from anthranilic acid.
   - **X.** Schotten Baumann Reaction: (β – Naphthyl benzoate from: [β – Naphtol / phenyl benzoate from phenol.
   - **XI.** Sulphonation reaction:Sulphanilic acid from aniline.
   - **XII.** Nitration: p-nitroacetanilide from acetanilide.
   - **XIII.** Hydrolysis: p-nitroaniline from p-nitroacetanilide and bromoaniline from p-bromoacetanilide.

Books Suggested:

1. Practical Organic Chemistry by A. 1. Vogel
2. Practical Organic Chemistry by Mann and Saunders.
3. Practical Organic Chemistry by Garg and saluja.
4. The systematic Identification of Organic Compounds by R.L. Shriner and D.Y. Curtin.
5. Semi micro Qualitative Organic Analysis, N.D. Cherois, J.B. Entikin and E.M. Hodnett.
6. A Handbook of Organic analysis by H.T. Clarke.
7. Advanced Practical Organic Chemistry by O.P.Agrawal.

SCHEME FOR PRACTICAL EXAMINATION

EXPERIMENT	MARKS
Experiment-1	30
Experiment-2	30
Viva-voce	20
Sessional Marks	20
TOTAL MARKS	**100**

M.Sc. CHEMISTRY SEMESTER-II
CH-12
LABORATORY COURSE – 04
Analytical Chemistry

MM 100
TIME: 6 Hrs.

Part-A. Analytical Chemistry

1. **Error Analytical and statistical data analysis:**
   Error, types of error, minimization of errors, statistical treatment for error analysis, standard deviation, method of least squares. Calibration of volumetric apparatus, burettes, pipettes, standard flask, weight box etc.

2. **Volumetric Analysis:**
   Determination of iodine and saponofication values of oil samples, Determination of DO, COD, BOD, hardness of water sample.

3. **Solubility:**
   - **a.** Determination of solubility of an inorganic salt in water at different temperature and hence plot the solubility curve.
   - **b.** Determination of transition temperature by solubility method.

4. **Chromatography:**
   - **a.** Separation of inorganic ions and amino acids by paper chromatography, column chromatography.
   - **b.** Separation and identification of the sugars present in given mixture of glucose, fructos and sucrose by paper chromatography and eterminatin of Rf values.
   - **c.** Thin – layer chromatography:- Separation of Ni, Mn, Co and Zn and determination of Rf values.

5. **Conductance of Electrolyte:**
   - **a.** Determination of basicity of organic acids.
   - **b.** Determination of degree of hydrolysis and hydrolysis constant of CH_3COONa & NH_4C1

6. **Flame Photometry/AAS/FIA:**
   Determination of cations, anions and metal ions e.g. Na, K, Ca, SO_4, NO_2, Fe, Mo, Ni.

7. **Spectrophotometry:**
   - **a.** Verification of Beer's law. Molar absorptivity calculation, plotting graph to obtain/ max etc. Study of colour change and pH range of some indicators.
   - **b.** Determination of some metal ions in various environmental samples.

8. **Nephlemetry / Turbidimetry**
   Determination of chloride, sulphate, phosphate, turbidity etc.

SCHEME FOR PRACTICAL EXAMINATION

EXPERIMENT	MARKS
Experiment-1	30
Experiment-2	30
Viva-voce	20
Sessional Marks	20
TOTAL MARKS	**100**