KISAN POST GRADUATE COLLEGE, BAHRAICH (UP) 271801
(An Autonomous College)

Proposed Structure of syllabus for the
PROGRAM: M.Sc.
SUBJECT: Chemistry

Syllabus developed by

S. No.	Name	Designation	Department	College/University
01	Mr. Roopchandra	Convener	Chemistry	Kisan P.G College Bahraich U.P.
02	Dr. P.N. Tripathi	University Nominee	Chemistry	Kisan P.G. College, Bahraich
03	Prof. J.P. Singh	Subject Expert	Chemistry	Shiya P.G. College, Lucknow
04	Prof. Arun Kumar Srivastava	Subject Expert	Chemistry	M.D. P.G. College, Pratapgarh
05	Dr. Smriti Verma	Member	Chemistry	Kisan P.G College Bahraich U.P
06	Dr. Manoj Kumar Mishra	Member	Chemistry	Kisan P.G College Bahraich U.P
07	Dr. Alok Pratap Singh	Member	Chemistry	Kisan P.G College Bahraich U.P

Course Code		Course Title	Credits	T/P	Evaluation	
					CIE	ETE
A	B	C	D	E	F	G
SEMESTER I (YEAR I)						
B020701T	CORE	Spectroscopy-I	5	T	25	75
B020702T	CORE	Symmetry & Molecular Vibration	5	T	25	75
B020703T	CORE	Organic Reaction Mechanism	5	T	25	75
B020704T	FIRSTELECTIVE **(Select any one)**	Chemical Kinetics & thermodynamics	5	T	25	75
B020705T		Surface & Solid-State Chemistry	5	T	25	75
B020706P	SECOND ELECTIVE **(Select any one)**	Chemistry Laboratory Course-I A	5	P	50	50
B020707P		Chemistry Laboratory Course-I B	5	P	50	50
SEMESTER II (YEAR I)						
B020801T	CORE	Chemistry of Main Group Elements	5	T	25	75
B020802T	CORE	Stereochemistry & Spectroscopy-I I	5	T	25	75
B020803T	CORE	Advanced Quantum Mechanics	5	T	25	75
B020804T	THIRDELECTIVE **(Select any one)**	Research Aptitude	5	T	25	75
B020805T		Environmental Science	5	T	25	75
B020806P	FOURTH ELECTIVE **(Select any one)**	Chemistry Laboratory Course-II A	5	P	50	50
B020807P		Chemistry Laboratory Course-II B	5	P	50	50
SEMESTER III (YEAR II)						
B020901T	CORE	Coordination & Bioinorganic Chemistry	5	T	25	75
B020902T	CORE	Pericyclic, Photochemistry & Rearrangement Reactions	5	T	25	75
B020903T	CORE	Electrochemistry	5	T	25	75
B020904T	FIFTHELECTIVE (Select any one)	Natural Products	5	T	25	75
B020905T		Medicinal Chemistry	5	T	25	75
B020906P	SIXTHELECTIVE (Select any one)	Chemistry Laboratory Course- III A	5	P	50	50
B020907P		Chemistry Laboratory Course- III B	5	P	50	50
SEMESTER IV (YEAR II)						
B021001T	CORE	Organ transition Metal Chemistry	5	T	25	75
B021002T	CORE	Organic Synthesis	5	T	25	75
B021003T	SEVENTH ELECTIVE (Select any one)	Analytical Chemistry	5	T	25	75
B021004T		Polymer Chemistry	5	T	25	75
B021001P	RESEARCH PROJECT / DISSERTATION	Practical Based Major Research Project /Dissertation	10	P	100	100

Program Outcomes (POs)

PO1: The program has been designed to enable the students to acquire strong theoretical, practical and research knowledge in the various areas of Chemistry.

PO2:The program covers maximum branches of Chemistry and Experimental Laboratory Courses as wet I as also gives emphasis on the research programme in Chemistry.

PO3:The practical courses have been designed to prepare the students to have experience of the laboratory skills in Chemistry so that students can work in any scientific laboratories which are the need in the current scenario for becoming the ATMAN1 RBHAR. Students wi11 be able to design and conduct experiments as well as to analyze and interpret scientific data in useful form.

PO4:Program will equipped students to face the employment challenges and instill confidence to turn into entrepreneur and also step into research career

PO5:The program will offer students with the knowledge and skill base that would enable them to undertake advanced studies in Chemistry and related areas or in multidisciplinary areas that involve Chemistry.

PO6: The students will gain domain knowledge and have right temperaments to know how to lead for successful career in academia, industry and research.

Program Specific Outcomes (PSOs)

PSO1: After successful completion of M Sc. Chemistry program, the student will be able to create an awareness of the impact of chemistry on the society and development outside the scientific community.

PSO2: Student will be able to analyze data obtained from various instruments viz. UV-Vis, Fluorescence, FTIR, NMR, TGA/DTA/DSC, GLC, GSC and HPLC for the structure determination and chemical analysis and student can apply different appropriate approach towards planning and execution of research in frontier areas of chemical sciences.

PSO3: After successful completion of this program, student can apply different appropriate approach towards planning and execution of research in frontier areas of chemical sciences.

PSO4: Student will become professionally trained and have caliber to do job in the various industries at all level of chemical, pharmaceutical, food products, life-oriented material industries.

Programme: Class: M.Sc. Previous	Year: I	Semester: I
Subject: Chemistry		
Course Code: B020701T	Paper: First	Course Title: Spectroscopy-I

Course outcomes:

CO-1. Students will acquire basic knowledge of UV-visible, infrared, Raman, microwave and diffraction techniques.

CO-2. Students will able to interpret Tate the spectra obtained from the various spectral (UV-visible, infrared & Raman, microwave, Mossbauer and diffraction methods) techniques.

CO-3. Students will able to focus their aim for future prospects of research in the above these spectroscopic techniques.

Credits: 05	Core
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
	Part I	
I	UV-Visible Spectroscopy: Different type of electronic transitions, Lambert-Beer's law, Chromophores, Auxochromes, Solvent effect, red shift and blue shift, Woodward's rule for conjugated cyclic and acyclic dienes and a, ß unsaturated carbonyl compounds, Absorption in - aromatic compounds (substituted benzene, naphthalene and anthracene), Problems related to UV- Visible Spectroscopy.	
II	Infrared Spectroscopy & Raman Spectroscopy: Linear harmonic oscillator, Vibrational energies of diatomic molecules, zero-point energy, force constant and bond strength, anharmonicity, Morse potential, Vibration- rotation spectroscopy, P, Q, R branches, Breakdown of Oppenheimer approximation, vibration of polyatomic molecules, selection rules, Group frequencies, Overtones, hot bands, factors affecting the bond positions and intensities for IR region, Problems related to Infrared Spectroscopy; Raman Spectroscopy: Classical and quantum theories of Raman effects, Pure rotational, Vibrational and Vibrational-rotational Raman spectra, Selection rule, Mutual exclusion principle, Resonance Raman spectroscopy, CARS.	
III	Microwave Spectroscopy: Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequency, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field applications.	
IV	Mossbauer Spectroscopy: Basic Principles, spectral parameters and spectrum display. Application of the technique to the studies of (a) bonding and structures of Fe and Fe" compounds including those of intermediate spin, (b) Sn2 and Sn4 compounds - nature of M-L bond, coordination number, structure and (c) detection of oxidation state and in equivalent MB atoms.	
V	Diffraction Techniques: X-ray Diffraction: General Features of diffraction, Powder X-ray diffraction, Single crystal X-ray diffraction. The technique, structure factor, phase problem, brief description of time resolved X-rays diffraction techniques; Electron Diffraction: Scattering intensity vs scattering angle, Wierl equation, Measurement technique, Elucidation of structure of simple gas phase molecules, Low energy electron diffraction structure of surfaces; Neutron Diffraction: Brief introduction, difference with X-rays diffractions.	

Suggested Readings

1. Fundamentals of Molecular Spectroscopy, 4th Ed. Mc Graw-Hill, C.N. Banwell.
2. Basic Principles of spectroscopy, Mc Graw-Hill, R. Chang
3. Modern Spectroscopy, J. M. Hollas, John Wiley.
4. Inorganic Electronic Spectroscopy, A. B. P. Lever, Elsevier.
5. Magnetochemistry, R. L. Carlin, Springer Verlag
6. K. Veera Reddy, Symmetry and Spectroscopy of Molecules, New Age.
7. Inorganic Chemistry, D. E. Shriver, P. W. Atkins and C. H. L. Langford, Oxford
8. Advanced Inorganic Chemistry, F. A. Cotton and G. Wilkinson, John Wiley.
9. Inorganic Chemistry, J. E. Huheey, Ellen A. Keiter, Richard L. Keiter, Addison Wesley Longman (Singapore) Pvt. Ltd

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Examinations	10
2	Assignment/ Seminar / Presentation / Quizzes	15

Programme: Class: M.Sc. Previous	Year: I	Semester: I
Subject: Chemistry		
Course Code: B020702T	Paper: Second	Course Title: Symmetry & Molecular Vibrations

Course outcomes:

CO-1: Students will have better understanding insight the symmetry elements and symmetry operations.

CO-2: Students will acquire the knowledge of symmetry of normal vibrations, determination of normal modes, mixing of internal coordinates and normal coordinate analysis of molecules.

CO-3: Students will focus their aim for future prospects of research in the field of symmetry & group theory.

Credits: 05	Core
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
	Part I	
I	Symmetry & Point Groups: Symmetry elements, Symmetry operations. Symmetry points group, Identification of molecular points group, Molecules of low symmetry, high symmetry and special symmetry (Cn. Sn. Dr. Cavs D only).	
II	Group, Subgroups, Classes and Matrices Representation: Definition, multiplication tables. group generating elements, subgroup, classes, derivation of matrices (C., o. i. S.). Direct product, Group multiplication basis, matrix representation, Character of an operation, orthogonality projection and shift operators, character table, orthogonality theorem, irreducible representation, Transformation matrices, structure of character table, determination of symmetry species for translations and rotations, construction of character table (C2, Civ).	
III	Valence Bond Theory: Formation of hybrid orbitals of XY) (planar), XY. (tetrahedral & square planar), Symmetry of orbital, orbital symmetry properties, Projection to get symmetry orbital, Projection operations, basis functions and hybrid orbitals with example.	
IV	Normal Coordinate Analysis: Cartesian coordinate and internal coordinate methods applied to C (symmetric XY2, ZXY2), Ca. (XY3), Ta. (XY) and O. (XY) systems.	
V	Molecular Vibrations: Internal and symmetry coordinates, SALC's, Symmetric normal vibrations, mixing of linear coordinates in normal modes, determination of symmetry types of normal modes. analysis of vibration of 1. 2 dichloroethylene, IR and Raman activity of some typical molecules (Cay Cay Case D. Dah Dan point group).	

Suggested Readings

1. Mc Weeny, "Symmetry - An Introduction to Group Theory", Pergamon Press. New York, 1969
2. Lowell H. Hall "Group Theory and Symmetry in Chemistry", McGraw Hill Book Company.
3. K. Veera Reddy, "Symmetry and Spectroscopy of Molecules", New Age International Limited Publisher, New Delhi.
4. D.M. Bishop, "Group theory and Chemistry" Dover Publications.
5. F.A. Cotton, "Chemical Applications of Group Theory", John Wiley, 1971. 6. M. Hamaresh, "Group theory and its Applications to Physical Problems" Addison-Wisley
6. Symmetry and Group theory: Some chemical applications, Ramashankar and Suresh Ameta, Himanshu Publications, Udaipur, Delhi.

Suggested Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S. No.	Assessment Type	Max. Marks
1	Examinations	10
2	Assignment/ Seminar / Presentation / Quizzes	15

Programme: Class: M.Sc. Previous	Year: I	Semester: I
Subject: Chemistry		
Course Code: B020703T	Paper: Third	Course Title: Organic Reaction Mechanism

Course outcomes: After successfully completion of this course:

CO-1: Students will train about the mechanistic approach about the mechanism of organic reactions.

CO-2: Students will acquire the knowledge general principle & outcome of various kinds of reactions viz, substitution reactions, addition reactions, elimination reactions and free radical reactions.

CO-3: Students will get idea to interpretate the mechanism of organic reactions and their products & prepare the students for further research in synthetic organic chemistry.

Credits: 05	Core
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
	Part I	
I	**Principle of Reaction Mechanism**: Potential energy diagram, Transition states and intermediates, methods of determining reaction mechanism, Labelling and kinetics isotopic effect and its importance in the determination of reaction mechanism, Hammond's postulate, Curtin Hammett principle, structural effects on reactivity, Hammett equation and linear free energy relation (LFER). Substituent and reaction constants, Taft equation.	
II	**Substitution Reaction**: Aliphatic Nucleophilic Substitution: SN, SN, SN, SN, SNSN", mixed SN and SN, role of substrate's structure, nucleophile, leaving group and solvent on SN reaction, am bidentate nucleophile, Regioselectivity, competition between SN and SN, Nucleophilic substitution in bridged system phenonium ion, norbornyl system, Neighboring group participation (Ph, n, o, N. S, negatively charged oxygen), an chimeric assistance. Aliphatic Electrophilic Substitution: SE and SE, SE accompanied by double bond shifts. Effect of substrate, leaving group and solvent polarity on reactivity. Aromatic Nucleophilic Substitution: Aromatic SN and SN. Addition- elimination and elimination-addition (benzyne) mechanism, effect of substrate structure, nucleophile, leaving group on ArSN reaction, Aromatic Electrophilic Substitution: General view, energy profile, Arenium ion mechanism (ArSE), o/p ratio.	
III	**Free Radical Reactions**: Types, generation, structures, radical effect, substitution mechanism at an aromatic substrate at a bridgehead, reactivity in the attacking radicals, effect of solvent on reactivity. Allylic halogenation (NBS), oxidation of aldehydes, autooxidation, Alkynes coupling and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction, Hunsdiecker reaction.	
IV	**Elimination Reaction**: E'. E. ElcB. Factors (substrate structure, attacking base. leaving group. medium) affecting these reactions, stereochemistry, orientation of the double bond (Saytzeff vs. Hofmann elimination). Mechanism and orientation of pyrolytic syn elimination, Competition between substitution and elimination reactions.	
V	**Addition Reaction**: C-C bond addition: Mechanism, stereochemistry, electrophilic, nucleophilic, free radical addition, addition of halogen acid, 1,2-dihydroxylation, epoxidation, hydroboration, oxymercuration-demercuration, hydrogenation of double bond, triple bond, aromatic ring cyclopropanation, Simmon-Smith cyclopropanation, epoxidation, Sharp less asymmetric epoxidation, corey epoxidation, Carbon hetero atom multiple bond addition: C-O bonds, cram rule, condensation reactions involving Claisen, Benzoin, Perkin, Knoevenagel, Darzen, Reformat sky and Cannizzaro reaction, Mechanism of hydrolysis of ester and amide, Ammonolysis of ester.	

Suggested Readings

1. Organic Chemistry, J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press.) 2. Advanced Organic Chemistry, A. F. A. Carey and R. J. Sundberg, 5th Ed. Springer (2007)
3. Advanced Organic Chemistry, J. March, 6th Ed.
4. Mechanism and structure in Organic Chemistry-E. S. Gould (Holt, Rinehart and Winston) 5. Guidebook to Mechanism in Organic Chemistry, Orient Longman, Sykes, P. A New Delhi.

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S. No.	Assessment Type	Max. Marks
1	Examinations	10
2	Assignment/ Seminar / Presentation / Quizzes	15

Programme: Class: M.Sc. Previous	Year: I	Semester: I
Subject: Chemistry		
Course Code: B020704T	**Paper: Fourth**	**Course Title: Chemical Kinetics & Thermodynamics**

Course outcomes:

CO-1. Students will be able to understand the various terms and concepts behind the chemical kinetics and thermodynamics.

CO-2. Students will be able to explore the phase rules and phase diagram thermodynamically.

CO-3. Students will have knowledge of molecular orbital theory in term of charge calculation, equilibrium constants, excess function Activities, Gibbs Helmholtz, Gibbs Duhem & Van't Hoff equation.

CO-4. Students will have knowledge of Non-Equilibrium Thermodynamics.

Credits: 05	Elective
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
	Part I	
I	**Chemical Kinetics:** Methods of determining rate laws, mechanism of photochemical (H2 + Br2, H2 + Cl2), chain stopped (H_2 equation + Br2, decomposition of CH3CHO, decomposition of C6H6), oscillatory reaction, collision theory, steric factor, Absolute reaction rate theory, comparison of result with Eyring and Arrhenius equation, steady state kinetics, kinetic and thermodynamic control of reactions, ionic reactions, kinetic salt effect, homogeneous catalysis, kinetics of enzyme reactions, heterogeneous catalysis, Fast reactions, luminescence and electron transfer process, flow technique, Relaxation method, flash photolysis, magnetic resonance method.	
II	**Chemical Equilibrium:** Free energy, entropy of mixing, partial molar quantities (free energy, volume, heat contents), Gibbs Duhem equation, Equilibrium constants, Van't Hoff equation, Fugacity and its determinations.	
III	**Ideal and Non-ideal Solution:** Excess function, activities, hydration number, activities in electrolytic solution, mean ionic activity coefficient, determination of activity, Phase rule, Phase diagram of one, two and three component systems.	
IV	**Non-Equilibrium Thermodynamics:** Postulates, methodologies, linear laws, Gibbs equation, Onsager reciprocal theory;	
V	**Statistical Thermodynamics:** Thermodynamic probability and entropy, concept of distribution, most probable distribution, Ensemble averaging, Maxwell-Boltzmann distribution, postulates of canonical, grand canonical, micro canonical ensemble, Bose-Einstein and Fermi-Dirac statics, partition function, translational, rotational, vibrational and electronic partition function for diatomic molecules, calculation of thermodynamic functions and equilibrium constant, theories cf specific heat for solids, application of partition function.	

Suggested Readings

Recommended Books:

1. P. W. Atkins, Physical Chemistry, Oxford University Press, New York.
2. S. Glasston, Physical Chemistry, Nostrand
3. K. L. Kapoor, Advance Physical Chemistry (Vol-1,2,3,4), Mac Millan, India
4. Puri, Sharma, Pathania, Advance Physical Chemistry.
5. M.C. Gupta, Statistical Thermodynamics, Second Edition, New Age International Limited Publisher.
6. Statistical Thermodynamics, Second Edition, New Age International Limited Publisher, India by M.C. Gupta.

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Examinatons	10
2	Assignment/ Seminar / Presentation / Quizzes	15

M.Sc. I (SEMESTER-I) PAPER-IV (Elective)
Title: Surface & Solid-State Chemistry

Programme: Class: M.Sc. Previous	Year: I	Semester: I
Subject: Chemistry		
Course Code: B020705T	Course Title: *Surface & Solid-State Chemistry*	

Course outcomes:
CO-I. Students will be able to understand the basics of surface chemistry, solid state reactions and electronic properties and band theory of the solids.
CO-2. Students will be able to apply the theoretical concepts of this course in proper applications.
CO-3. This course will motivate students to enhance their knowledge in this field via research.

Credits: 05	Elective
Max. Marks: 25+75	Min. Passing Marks:

Unit	Topics	No. of Lectures
	Part I	
I	**Surface Chemistry**: Adsorption: Surface Tension, capillary action, Laplace equation, Kelvin equation, Gibb's adsorption isotherm, BET equation, Electric kinetic phenomenon.	
II	**Micelles**: Surface active agents, classification, micellization, hydrophobic interaction, CMC, factors affecting CMC, Counter ion binding to micelles, solubilization, micro emulsion, reverse	
III	**Solid State Reactions**: General principles, experimental procedures, co-precipitation as a precursor to solid state reactions, kinetics of solid-state reactions, Crystal Defects and Non-Stoichiometry, Perfect and imperfect crystals, intrinsic and extrinsic defects - point defects, line and plane defects, vacancies, Schottky and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, colour centers, non-stoichiometry and defects.	
IV	**Electronic Properties and Band Theory**: Metals, insulators and semiconductors, electronic structure of solids-band theory, band structure of metals, insulators and semiconductors. Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, super conductors. Capital Properties - Optical reflectance, photoconduction.	
V	**Magnetic Properties**: Classification of materials: Quantum theory of paramagnetic- cooperative phenomenal magnetic domains, hysteresis; Organic Solids: Electrically conducting solids, organic charge transfer complex, organic metals, new superconductors.	

Suggested Readings

1. Solid Sate Chemistry and its Application, A. R. West, Plenum.
2. Principal of The Solid state, H. V. Keer, Wiley Eastern.
3. Solid Sate Chemistry, N. B. Hannay.
4. Solid Sate Chemistry, D.K. Chakrabarty, New age International.

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S. No.	Assessment Type	Max. Marks
1	Examination	10
2	Assignment/ Seminar / Presentation / Quizzes	15

M.Sc. I (SEMESTER-I) PAPER (Practical)
Title: Chemistry Laboratory Course-I A

Programme: Class: M.Sc. Previous	**Year: I**	**Semester: I**
Subject: Chemistry		
Course Code: B020706P	**Course Title: *Chemistry Laboratory Course-I A***	

Course outcomes: After completion of this course students will acquire the knowledge of:

CO-1. Qualitative analysis of inorganic mixtures containing one rare element of first & second group & paper chromatographic separation techniques of cations.

CO-2. Qualitative analysis of binary organic mixture and paper chromatographic technique for the separation of mixture of amino acids.

CO-3. Chemical kinetics, thermochemistry and phase equilibria.

Credits: 05	**Elecitive**
Max. Marks: 50+50	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	**Topics**	**No. of Lectures**
	Part I	
I	INORGANIC CHEMISTRY Qualitative analysis: Qualitative analysis of an inorganic mixture of seven radicals including one rare element of first & second group (TI, W, Se, Mo, and Te). Semi- micro analysis is to be done. Mixture can have insoluble substances, interfering anions and combination of anions. Chromatography: Chromatographic separation of first and second group metal ion of the following combinations: i. Pb^{2}+, Ag+, $Hg2^{2}$+ ii. Pb^{2}+, Cd^{2}+, Cu^{2}+ iii. Bi^{3}, Cd^{2}+, Hg^{2}+	
II	ORGANIC CHEMISTRY Qualitative Analysis: Separation, purification and identification of components of binary organic mixture (both solids, one solid & one liquid). Systematic analysis of each component laying emphasis on solubility, element detection, melting point, boiling point determination, ignition test, unsaturation test, functional group test, specific test and preparation of suitable derivative. Chromatography: Separation, identification and determination of Rf value of the components present in the binary mixture of amino acids by paper chromatographic methods.	
III	PHYSICAL CHEMISTRY Chemical Kinetics: i. Kinetics of ester (methyl acetate) hydrolysis in presence of acid. ii. Determine the velocity constant and order of reaction for hydrolysis of ethyl acetate by sodium hydroxide at given temperature (saponification of an ester). iii. Kinetics of acetone and 12 iv. Kinetics of KBrO3/KI v. Kinetics of Na2S2O8/HCl Thermochemistry/Phase Equilibria: i. Determination of the solubility of benzoic acid in water at different temperatures and calculate the heat of solution. ii. Determination of the solubility of a salt (KCl, KNO3) at different temperatures and calculate the heat of solution. iii. Construct the phase diagram for three component Ethanol, benzene and water system. iv. Construct the phase diagram for three component chloroform, acetic acid and water system. v. v. Construct the phase diagram for two component system.	
	System of Marking:-Time: 12h Physical: 33 Inorganic: 33 Organic: 34	
	Recommended Books:	

	1. Experimental Inorganic Chemistry by Mounir A, Malati, Horwood series in Chemical Science (Horwood publishing Chichester) 1999. 2. Practical Inorganic Chemistry, G. Marrand, B.W. Rockett, Van Nostrand. 2. Practical Physical Chemistry, A.M. James and F.E. Prichand, Longman. 3. Findley's Practical Physical Chemistry revised, B.P. Levitt, Longman. 4. Experimental Physical Chemistry, R.C. Das and Bebera, Tata Mc Grawhill. 5. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Barg (R. Chand and Co., Delhi) 7. Experimental Physical Chemistry by D.P. Shoemaker Mc Grawhill, 7th Edition 2003. 6. Experiments in Chemistry, D.V. Jahagirdar, Himalaya Publishing House.. 9. Practical Physical Chemistry, B. Vishwanathan and P.S. Raghwan, Viva Books. 7. 10. General Chemistry Experiments, Anil J Elias, University Press (2002) 8. 11. Experimental Physical Chemistry, V.D. Athawale, ParulMathur, New Age International (P) 9. Limited. 10. 12. Systematic Experiment in chemistry, ArunSethi, New Age International (P) Limited. 11. 13. The systematic Indentification of Organic Compounds, R.L. Shringer and D.Y. Curlin.	

M.Sc. I (SEMESTER-I) PAPER (Practical)
Title: Chemistry laboratory Course-I B

Programme: Class: M.Sc. Previous	**Year: I**	**Semester: I**
Subject: Chemistry		
Course Code: B020707P	**Course Title: *Chemistry Laboratory Course-I B***	
Course outcomes: After completion of this course students will acquire the knowledge of: CO-1. Qualitative analysis of inorganic mixtures having one rare element of third chromatographic separation techniques of metal ions of third group. group & paper CO-2. Qualitative analysis of binary organic mixture having both liquid components and TLC separation of mixture of sugars. CO-3. Colloidal & surface chemistry and molecular weight measurements.		
Credits: 05	**Elective**	
Max. Marks: 50+50	**Min. Passing Marks:**	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:		

Unit	**Topics**	**No. of Lectures**
	Part I	
I	**INORGANIC CHEMISTRY** Qualitative analysis: Qualitative analysis of an inorganic mixture of seven radicals including one rare element of third group (Be, U, Ti, Zr, Th, Ce, V and Li). Semi- micro analysis is to be done. Mixture can have insoluble substances, interfering anions and combination of anions. following combinations: Chromatography: Chromatographic separation of third, fourth & fifth group metal ion of the following combinations. iv. i. $Fe^{3}+$, $Cr^{3}+$, $Al^{3}+$ ii. $Co^{2}+$, $Ni^{2}+$, $Zn^{2}+$ iii. $Ba^{2}+$, $Sr^{2}+$, $Ca^{2}+$	
II	ORGANIC CHEMISTRY Qualitative Analysis: Separation, purification and identification of components of binary organic mixture (both liquids), Systematic analysis of each component leading to their final identification laying emphasis on solubility, element detection, melting point, boiling point determination, ignition test, unsaturation test, functional group test, specific test and preparation of suitable derivative. Chromatography: Separation, identification and determination of Rf value of the components present in the binary mixture of sugars by thin layer chromatographic methods.	
III	PHYSICAL CHEMISTRY **Colloidal & Surface Chemistry:** i. Critical Micelle Concentration (CMC) of Surfactants by surface tension measurement, ii. To determine the adsorption of aq. acetic acid by activated charcoal and study the adsorption (Freundlich isotherm). iii. To study the adsorption of oxalic acid on charcoal and draw the Freundlich isotherm. iv. Find out surface tension, molecular energy and Parachor of given liquid at room temperature. v. To prepare As2O3 and Fe $(OH)_3$; sol. vi. To prepare Al $(OH)_3$; sol and sulphur sol. **Molecular Weight Measurements:** i. To determine molecular weight of a given electrolyte by elevation in boiling point method (Lands Berger method) and also find out its Van't Hoff factor. iii. Determine molecular weight of a given electrolyte by depression in freezing point method. ii. ii. To determine molecular weight of a given polymer by viscosity method.	
	System of Marking: - Time: 12h Physical: 33 Inorganic: 33 Organic: 34	
	Recommended Books: 1. Experimental Inorganic Chemistry by Mounir A, Malati, Horwood series in Chemical Science (Hor wood publishing Chic Hester) 1999. 2. Practical Inorganic Chemistry, G. Marrand, B.W. Rockett, Van Nostrand. 3. The systematic Indentification of Organic Compounds, R.L. Shringer and D.Y. Curlin. 4. Practical Physical Chemistry, A.M. James and F.E. Prichand, Longman. 5. Findley's Practical Physical Chemistry revised, B.P. Levitt, Longman. 6. Experimental Physical Chemistry, R.C. Das and Bebera, Tata Mc Grawhill. 7. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Barg (R. Chand and Co., Delhi) 8. Experimental Physical Chemistry by D.P. Shoemaker Mc Grawhill, 7th Edition 2003. 9. Experiments in Chemistry, D.V. Jahagirdar, Himalaya Publishing House. 10. Practical Physical Chemistry, B. Vishwanathan and P.S. Raghwan, Viva Books. 11. General Chemistry Experiments, Anil J Elias, University Press (2002) 12. Experimental Physical Chemistry, V.D. Athawale, Parul Mathur, New Age International (P) Limited. 13. The systematic Indentification of Organic Compounds, R.L. Shringer and D.Y. Curlin. 14. Systematic Experiment in chemistry, ArunSethi, New Age International (P) Limited.	

M.Sc. I (SEMESTER-II) PAPER-I Title: Chemistry of Main Group Elements		
Programme: Class: M.Sc. Previous	**Year: I**	**Semester: II**
Subject: Chemistry		
Course Code: B020801T	**Course Title: Chemistry of Main Group Elements**	

Course outcomes: After completion of this course students will be able to:
CO 1. Understand of correlation between electronic configuration and bonding properties of main
CO 2. Focus their aim for future prospects of research in the field of chemistry of main group

Credits: 05	**Core**
Max. Marks: 25+75	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
	Part I	
I	Stereochemistry of Bonding Among Main Group Elements: VSEPR theory stereochemical rules and explanation of the shapes of molecules and ions of nontransition element with 2-7 valence shell electron pairs. Walsh diagram (Tri and penta atomic molecules) dr-pa bonds, Bent rule, Energetics of hybridization.	
II	Compounds of Main Group Elements: Preparation, Structure, Bonding and Technical Applications of Polyether complexes of alkali and alkaline earth metals; Polyphasphazenes and Thiazyl & its polymers, tetrasulfur dinitride.	
III	Structure and Bonding in Ions of Some Main Group Elements: Structure and bonding of borane anions, higher boranes, carboranes, classification and structures of silicates.	
IV	Carbides & Polyanions: Synthesis and structure of Carbides & polyions of Ge, Sn, Pb, Sb, Bi and Hg.	
V	Hapticity & Organometallics: Definition and classification of organometallic compounds on the basis of hapticity and polarity of metal-carbon bond; Preparation, Properties, Structure and Applications of alkyl and aryls of Lithium, Beryllium, Aluminum, Mercury and Tin.	

Suggested Readings:

1. Advance Inorganic Chemistry, 6th Edition, Cotton and Wilkinson.
2. Inorganic Chemistry, 4th Edition, Principles of Structure and Reactivity by J.F. Huheey, E.A.Keiter and R.L. Keiter, 1993
3. Chemistry of Elements by N.N. Greenwood and A. Emshaw, Butterworths 1997.
4. Organometallic Chemistry: A Unified Approach by R.C. Mehrotra and A.K. Singh
5. Comprehensive Coordination Chemistry Vol.3 by G. Wilkinson, R.D. Gillard, And J.A. McCleverty, Pergamon Press 1987.

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Examinatons	10
2	Assignment/ Seminar / Presentation / Quizzes	15

M.A./M.Sc. I (SEMESTER-II) PAPER-I Title: Stereochemistry & Spectroscopy-II		
Programme: Class: M.Sc. Previous	**Year: I**	**Semester: II**
Subject: Chemistry		
Course Code: B020802T	**Course Title: Stereochemistry & Spectroscopy-II**	

Course outcomes:

CO-1. Students will be able to demonstrate an intuitive understanding of concepts of stereochemistry and spectroscopy 1.

CO-2. After studying this course, the students will be able to have understanding of various classes of stereoisomers and also have knowledge to establish the structure of the molecules by analyzing their various spectral data.

CO-3. Stereochemistry and spectroscopy I cover a wide area of research in organic chemistry and hence this course will motivate students to enhance their knowledge in this field via

Credits: 05	**Core**
Max. Marks: 25+75	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
	Part I	
I	Stereochemistry: Stereochemistry with chiral centre:chirality, Polychiral centre molecules, Threo- erythro isomers, stereoisomerism with axial/ planar chirality and Helicity, Principle of axial and planar chirality, optical isomerism in the absence of chiral carbon (biphenyl, allenes, spiranes), optical activity due to intermolecular overcrowding, chirality due to helical shape. Absolute configuration (R/S, E/Z), Stereochemistry of compounds having S, N, P atoms, Geometrical isomerism of compounds having C-N, NN bonds; Topocity and Prostereoisomeriam: Homotopic, enantiotopic and diastereotopic atoms, groups and faces, nomenclature and symbols, Atropisomerism: Conformational analysis of acyclic system, Interconversion of Fischer, Newmann and Sawhorse projection, its effect on activity (SN', SN, E'. E) configuration, conformation and stability of cycloalkanes, mono and disubstituted cyclohexane, cyclohexenones, decalin, decalol.	
II	Proton Magnetic Resonance Spectroscopy: Spinning nuclei, nuclear spin, nuclear resonance,saturation, chemical shift, chemical shift measurement, factors affecting the chemical shift. anisotropic effect, shielding mechanism, spin spin coupling, coupling constant, chemical exchange, effect of deuteration, factor influencing coupling constant J. Karplus curve-variation of coupling constant with dihedral angle, Spin decoupling, simple, virtual and complex coupling. chemical and magnetic equivalence, first and non-first order spectra, analysis of AB, AMX and ABX system, simplification of complex spectra, contact shift reagents, solvent effects. NOE, hindered rotation and rate process, NMR studies of "F. "P. instrumentation, FT NMR & its advantages, DEPT, 2DNMR: COSY, NOESY, HETCOR, application of 'H NMR spectra in structural determination of simple organic molecules, use of NMR in medical.	
III	Carbon Magnetic Resonance Spectroscopy: Introduction, peak assignment, chemical shift, "C- 'H coupling, off resonance, decoupling, deuterium, fluorine and phosphorous coupling. DEPT. 2DNMR: COSY, NOESY, application to simple organic molecules (aliphatic, olefinic. alkyne, aromatic, heteroaromatic and carbonyl carbon).	
IV	ESR Spectroscopy: Basic principles, zero field splitting and Kramer's degeneracy, factors affecting 'g' value, Isotropic and anisotropic hyperfine coupling constants, Application to organic free radicals-methyl free radical, naphthalene and benzene free radicals, CIDNP.	
V	Mass Spectrometry: Measurement technique (EI, CI, FD and FAB), Ion production, factors affecting fragmentation, group metastable peak, Ion analysis, Molecular base and molecular ion, Ion abundance, factors affecting Ion abundance, Me Lafferty rearrangements, retro Diels Alder fragmentation, Nitrogen rule, determination of molecular composition, fragmentation patterns of organic compounds, common functional group with reference to their structure determination, Interpretation of mass spectra, High resolution mass spectrometry.	

Suggested Readings

1. Stereochemistry of Organic Compounds, Nasipuri, New Age International (P) Limited.
2. Stereochemistry of Carbon Compounds, E. L. Eliel and S. H. Wilen
3. Spectrometric Identification of Organic Compounds, Silverstein and Webster, John Wiley, New York.
4. Organic Spectroscopy, P. S. Kalsi, New Age International (P) Limited.
5. Introduction to Spectroscopy, Pavia, Lampman, Kriz, Vyvyan, Cengage Learning.
6. Organic Spectroscopy, I Fleming, McGraw-Hill Inc., US.
7. Organic Spectroscopy, W. Kemp, Macmillan, London.

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Examinatons	10
2	Assignment/ Seminar / Presentation / Quizzes	15

M.A./M.Sc. I (SEMESTER-II) PAPER-III		
Programme: Class: M.Sc. Previous	**Year: I**	**Semester: II**
Subject: Chemistry		
Course Code: B020803T	**Course Title: Advanced Quantum Mechanics**	

Course outcomes: After completion of this course students will able to: CO 1. Understand about molecular structures and properties, quantum states live in a vector space, to relate abstract formulation to wave and matrix mechanics.
CO-2. Understand about perturbation theory, level splitting and radiative transitions, role of angular momentum in atomic and nuclear physics relation between conservation laws and symmetries.
CO-3. Focus their aim for future prospects of research in the field of quantum chemistry

Credits: 05	**Core**
Max. Marks: 25+75	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
	Part I	
I	ymmetry Properties and Quantum Mechanics: Invariability of Schrodinger Equation for a molecule with respect to symmetry operations and its consequences. Construction of molecular orbitals ammonia and pie molecular orbitals of naphthalene, the direct product representation and its application in the derivation of selection rules for electronic, vibrational and Raman spectra.	
II	Huckel MOT of Conjugated Systems and its Applications: Calculation of energy levels and delocalization energy of butadiene, cyclic conjugated systems: cyclopropenyl, cyclobutadiene, cyclopentadienyl, benzene, brief idea about delocalization energies of tropylium radical and cyclooctatetraene, concept of aromaticity and antiaromaticity, Huckel treatment of linear polyenes.	
III	Semi-Empirical and Ab-Intio SCF Theories: Hartee-Fock Self consistent (SCF) method, Semi empirical SCF theory (CDNO, INDO & MNDO), Slater and Gaussian type orbitals. Configurational interaction and electron correlation, Moellar-Plasset perturbation methods.	
IV	Introduction to Density Functional Theory: Concept of basis sets, exchange- correlation energy. The Hohenberg variational theorem and Kohn- Sham orbitals. The Local Density Approximation (LDA) and Generalized Gradient Approximation (GGA). Density Functional theory and its significance.	
V	Molecular Mechanics: A brief introduction to molecular mechanics.	

Suggested Readings:

1. Quantum Chemistry by Donald A. Macquarrie
2. Physical Chemistry by T. Engel and P. Reid
3. Introductory Quantum Chemistry by A. K. Chandra
4. Quantum Chemistry by R. K. Prasad
5. Molecular Quantum Mechanics by Atkins and Friedman
6. Quantum Chemistry by Ira N. Levine, Prentice Hall of India, New Delhi 1995
7. Chemical Application of Group Theory by F. A. Cotton

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Examinatons	10
2	Assignment/ Seminar / Presentation / Quizzes	15

M.A./M.Sc. I (SEMESTER-II) PAPER-IV (Elective)		
Programme: Class: M.Sc. Previous	**Year: I**	**Semester: II**
Subject: Chemistry		
Course Code: B020804T	**Course Title: Research Aptitude**	

Course outcomes: After completion of this course students will be able to:
CO 1. Understand the basic of this course and think & develop new ideas in this course.
CO 2. Understand how-to do-good quality of research work systematically.
CO 3. Understand how to do write the research projects and scientific papers.

Credits: 05	**Elective**
Max. Marks: 25+75	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
I	Elementary of Basic Research: Definition & objectives of research, motivation in research, research, methodology, literature survey, primary source, secondary source, reprint, importance of literature survey in defining problem and selection of topic of research, distinction between theoretical and applied research, various stages of scientific research, criteria of good research, research area in chemical sciences, significance of research in chemical sciences.	
II	Chemical Abstract and Review Writing: Chemical abstract types, survey of abstract indexes index, author index, general technique index, collective and comprehensive indices); monograph and treaties on specific areas, understanding of terminology text. reference, comprehensive survey, vocabulary regarding book, citation index, impact factor, H-index. e- consortium, preparation of a review article related to the research problem, writing scientif: report, planning of writing, preparation, draft, revision, refining, research report format, writing iterature surveys and reviews.	
III	Digital Resources for Research and Error Analysis: Web resources, e-Journal access, UGC infonet, e-books, internet discussion, groups and communities blog, preprint server, search engines- scirus, google scholar, chemindustry, wiki-database, chemspider, science direct, sciFinder, scopus. elementary of error's analysis.	
IV	Types of Scientific Papers and its Communications: Original research papers, patents, reviewpapers, symposium papers, invited papers, conference proceeding as full papers, format of researchpapers, components of thesis: Special Elements: Footnote, number, quantities, SI units, functions,mathematical expression and equations, tables, figure, captions, link between figure and text, line drawing, diagrams and graphs, punctuation, common proof marks that may be used to correct amanuscript; Research Work Writing & Presentations: poster display, oral presentation, knowledge about seminar, symposium, conferences, convention, congress, workshop.	
V	Financial Assistance & Research Ethics: Elementary of writing of research proposal, role of funding agencies like UGC, CSIR, ICAR, ICMR, ISRO, DRDO, DST, DBT, CST in R&D of chemical sciences; Plagiarism: Definition, consequences, avoidance.	

Suggested Readings:
1. Research Methodology, C.R Kothari, New Age International Publication, 2004.
2.J Writing and Presentation Scientific Papers 2 /e; Malmfors, Grossman, Viva Book Pvt. Ltd.
3. How to write a successful science Thesis; Russey, Ebel, Bliefest, Wiley-VCH.
Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Examinatons	10
2	Assignment/ Seminar / Presentation / Quizzes	15

M.Sc. I (SEMESTER-II) PAPER-IV (Elective)

Title: Environmental Science

Programme: Class: M.Sc. Previous	**Year: I**	**Semester: II**
Subject: Chemistry		
Course Code: B020805T	**Course Title: Environmental Science**	

Course outcomes: After completion of this course:
CO-1. Students will be able to understand various terms and concepts behind the environmental chemistry.
CO-2. Students will have deeper understanding on various environmental issues viz. fate of chemical species in soil, water and air.
CO-3. Students will get deeper insight about industrial pollution and chemical toxicology.

Credits: 05	**Core**
Max. Marks: 25+75	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	**Topics**	**No. of Lectures**
I	Basics of Environment: 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	Atmosphere: Regions, chemical composition of atmosphere,, Particles, ions & radicals and their formation, Chemical & photochemical reaction in atmosphere, smog formation, oxides of N,C,S,O and their effect, pollution by chemicals, petroleum, minerals, ozone layer, ozone layer depletion. chlorofluoro hydrocarbons, Green House effect, acid rain, Global warming. Analytical methods for measuring air pollutants, continuous monitoring instruments.	
III	Hydrosphere: Chemical composition of water bodies viz. lakes, streams, rivers, and wet lands. Hydrological cycle, Recycle of waste water, Sewage treatment; Water pollution: Inorganic, Organic, Pesticide, Agricultural, Industrial and Sewage, detergents, oil spills and oil pollutants. Water quality parameters-dissolved oxygen, biochemical oxygen demands, solids metals, content of chloride, sulphate, phosphate, nitrate and micro-organisms water quality standards, Analytical methods for measuring DO, BOD and COD, residual chloride and chlorine demand, Purification and treatment of water.	
IV	Soil: Composition, micro and macro nutrients, Pollution-fertilizers, pesticides, plastics and metals,waste treatment.	
V	Industrial Pollution: Cement, sugar, distillery, drug, paper and pulp, thermal power plants, nuclear power plants, metallurgy, polymers, drugs etc. Radionuclide analysis, Disposal of Wastes and their management; Environmental Toxicology: Toxic chemicals in the environment, Chemical sclution to environment, Principles of decomposition, biodegradability, better industrial process.	

Suggested Readings

1. Manahan, Stanley E. Fundamentals of Environmental Chemistry Boca Raton: CRC Press, LLC, 2001.
2. Sonja Krause, Herbert M. Clark, James P. Ferris, Robert L. Strong Chemistry of the Environment, Elsevier Science & Technology Books, 2002.
3. Eugene R. Weiner Applications of Environmental Chemistry 2000 CRC
4. By Clair, N. Sawyer, Perry L. Mc Carty, Gene F. Parking Chemistry for environmental engineering and Science (5 edition) McGraw Hill Professional.

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	**Assessment Type**	**Max. Marks**
1	Examinations	10
2	Assignment/ Seminar / Presentation / Quizzes	15

M.A./M.Sc. I (SEMESTER-II) PAPER (Practical)		
Programme: Class: M.Sc. Previous	**Year: I**	**Semester: II**
Subject: Chemistry		
Course Code: B020806P	**Course Title: Chemistry laboratory Course-II A**	

Course outcomes: After completion of this course students will acquire the knowledge of:

CO-1. Quantitative estimation (one volumetrically and other gravimetrically) of the metals present in the inorganic mixtures.

CO-2. Paper chromatographic (paper) separations of sugars.

CO-3. Preparation of the inorganic and organic compounds

CO-4. Various theories and principles behind the experiment of. Solubility & distribution coefficient, optical methods (calorimetry, refractometers and polarimetry).

Credits: 05	**Elective**
Max. Marks: 50+50	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
	Part I	
I	**INORGANIC CHEMISTRY** Quantitative Analysis: Estimation of two metal ions (one gravimetric and other volumetric) from the following mixtures: i. Ni^{2}+ and Cu^{2}+ ii. Pb^{2}+ and Cu^{2}+ iii. Ba^{2}+ and Cu^{2}+ iv. Ag+ and Cu^{2}+ **Inorganic Preparation:** Check the purity of the synthesized compounds by TLC and report the percentage of yield. i. K3 [Cr(C2O4)3]. 3H2O ii. [Co (NH3) 4.CO3]NO3 iii. NH4 [Cr (SCN)4 (NH3)2]H_2O iv. (NH4)2 [PbCl6] v. Hg [Co (SCN)4] vi. Ni(DMG)2	
II	ORGANIC CHEMISTRY Organic Synthesis: Two steps synthesis involving following reactions and check the purity of the synthesized compounds by TLC and report the percentage of yield:- i. Acetylationii. Hydrolysis ii. Oxidation iii. Aromatic electrophilic substitution iv. Condensation v. Sandmeyer reaction Chromatography: Separation and identification of the sugars present in the organic mixture by paper chromatographic methods and determination of Rf value.	
III	PHYSICAL CHEMISTRY Solubility & Distribution Coefficient: i. To draw the solubility curve for water-acetic acid-chloroform system. ii. Determination of the distribution coefficient of acetic acid between benzene and water. iii. Determination of the distribution coefficient of iodine between carbon tetrachloride and water. iv. Determination of the dimerization constant of benzoic acid in benzene medium by partition method. v. Solubility of an organic acid in water at room temperature. **Optical Methods (Colorimetry, Refractometry and Polarimetry):** i. To verify Lambert's Beer Law colorimetrically. ii. Determine the rate constant for inversion of cane sugar using a polarimeter. iii. iii. Determination of the molar refractivity of methyl alcohol, acetic acid, ethyl acetate and carbon tetrachloride and calculate the refraction equivalents of carbon, hydrogen and chloride atoms.	
	System of Marking: - Time: 12h Physical: 33, Inorganic: 33, Organic: 34	
	Recommended Books: 1. Vogels Text book of Quantitative Analysis revised, J. Bessett, R.C. Denney, G.H. Jellery and J. Mendhan ELBS. 2. Microscale Inorganic Chemistry, Z. Scafran, R.M. Pike and M.M. Singh Wiley. 3. Practical Inorganic Chemistry, G. Marrand, B. W. Rockett, Van Nostrand. 4. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley. 5. Systematic Experiment in chemistry, Arun Sethi, New Age International (P) Limited. 6. Practical Physical Chemistry, A.M. James and F.E. Prichand, Longman.	

	7. Findley's Practical Physical Chemistry revised, B.P. Levitt, Longman. 8. Experimental Physical Chemistry, R.C. Das and Bebera, Tata Mc Grawhill. 9. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Barg (R. Chand and Co., Delhi) 10. Experimental Physical Chemistry by D.P. Shoemaker Mc Grawhill, 7th Edition 2003. 11. Experiments in Chemistry, D.V. Jahagirdar, Himalaya Publishing House. 12. Practical Physical Chemistry, B. Vishwanathan and P.S. Raghwan, Viva Books. 13. General Chemistry Experiments, Anil J Elias, University Press (2002) 14. Experimental Physical ChemistryPractical Physical Chemistry revised, B.P. Levitt, Longman. 15. Experiments in Physical chemistry, J.C. Ghosh, Bharati Bhavan. 16. Advanced Practical Physical Chemistry, JB Yadav.	

M.A./M.Sc. I (SEMESTER-II) PAPER (Practical)		
Programme: Class: M.Sc. Previous	**Year: I**	**Semester: II**
Subject: Chemistry		
Course Code: B020807P	**Course Title: Chemistry Laboratory Course-II B**	
Course outcomes: After completion of this course students will acquire the knowledge of: CO-1. Quantitate estimation of the metals present in the inorganic mixtures. CO-2. Thin layer chromatographic separations of component present in the organic mixture. CO-3. Preparation and identifications of the inorganic and organic compounds by using various spectral techniques CO-4. Various theories and principles behind the experiment of conductance measurement and flame photometry.		
Credits: 05	**Elective**	
Max. Marks: 50+50	**Min. Passing Marks:**	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:		

Unit	Topics	No. of Lectures
	Part I	
I	INORGANIC CHEMISTRY Quantitative Analysis: Gravimetric estimation of two metal ions from the following mixtures: i. Cu^{2}+ and Ni^{2}+ ii. Cu2+ and Zn2+ iii. Zn2+ and Ni^{2}+ iv. Cu2+ and Fe2+ v. Ni^{2}+ and Fe2+ Inorganic Preparation: Identification of the synthesized inorganic compounds by using their spectral data (UV, IR andMass spectroscopy) i. Trans K[Cr(C2O4)2 (H2O)2]. $2H_2O$ ii. Ferric alum (ferric ammonium sulphate) iii. Prussian blue iv. [Cu (NH3)4] SO4.H2O	
II	**Organic Synthesis:** Two steps synthesis Identification of the synthesized organic compounds by using their spectral data (UV, IR, 'HNMR, 13 CNMR and Mass spectroscopy). **Chromatography:** Separation and identification of the components present in the given organic mixture by thin layer chromatographic methods and determination of Rf value.	
III	**PHYSICAL CHEMISTRY** **Conductance Measurement:** i. Study the hydrolysis of aniline hydrochloride by conductance method. ii. Determination of basicity of a given salt by conductance method. iii. Conductometric titration of strong acid with strong base. iv. Conductometric titration of weak acid with strong base. v. Verification of Ostwald's dilution law. vi. Verification of Kohlrausch's law Flame Photometry: i. Estimation of sodium and potassium in admixture. ii. Estimation of magnesium and calcium in tap water.	
	System of Marking: -Time: 12h Physical: 33 Inorganic: 33 Organic: 34	
	Recommended Books: 1. Vogels Text book of Quantitative Analysis revised, J. Bessett, R.C. Denney, G.H. Jellery and J. Mendhan ELBS. 2. Microscale Inorganic Chemistry, Z. Scafran, R.M. Pike and M.M. Singh Wiley. 3. Practical Inorganic Chemistry, G. Marrand, B. W. Rockett, Van Nostrand. 4. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley. 5. Systematic Experiment in chemistry, Arun Sethi, New Age International (P) Limited. 6. Practical Physical Chemistry, A.M. James and F.E. Prichand, Longman. 7. Findley's Practical Physical Chemistry revised, B.P. Levitt, Longman. 8. Experimental Physical Chemistry, R.C. Das and Bebera, Tata Mc Grawhill. 9. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Barg (R. Chand and Co., Delhi) 10. Experimental Physical Chemistry by D.P. Shoemaker Mc Grawhill, 7th Edition 2003. 11. Experiments in Chemistry, D.V. Jahagirdar, Himalaya Publishing House. 12. Practical Physical Chemistry, B. Vishwanathan and P.S. Raghwan, Viva Books. 13. General Chemistry Experiments, Anil J Elias, University Press (2002) 14. Experimental Physical ChemistryPractical Physical Chemistry revised, B.P. Levitt, Longman. 15. Experiments in Physical chemistry, J.C. Ghosh, BharatiBhavan.	

M.Sc. II (SEMESTER-III) PAPER-I		
PROGRAMME: CLASS: M.Sc.	**YEAR: II**	**SEMESTER: III**
SUBJECT: CHEMISTRY		
COURSE CODE: B020901T	**COURSE TITLE: Coordination & Bioinorganic Chemistry**	

Course outcomes:

- After completion of this course students will able to:
- Know the basic terms & principles behind coordination compounds & and bioinorganic chemistry.
- Understand about energy level in an atom, free ions in crystal field, electronic spectra, magnetic properties and metal ligand bonding in transition metal complexes.
- Focus their aim for future prospects of research in the field of coordination & bioinorganic chemistry.

Credits: 05	**Core**
Max. Marks: 25+75	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
I	**Basics of Energy Level in Atoms:** Electronic configuration, coupling of orbital angular momenta, coupling of spin angular momenta, spin orbital coupling, energy terms, Determining the ground state terms -Hund's rules. Determination of term symbol for a closed subshell, Hole formulation, Derivation of terms for a d' configuration. Inter electron repulsion parameter. Variation of Racah B and C parameters in different transition series. Spin orbit coupling parameters.	
II	**Free Ions in Crystal Fields:** Effect of weak crystal field on free ion terms in octahedral, square planar and tetrahedral symmetries. Orgel diagrams, mixing of terms, Medium and strong field approximation in Oh point group, transition from weak to strong field and correlation diagram for only d2 case, non-crossing rule, Tanabe Sugano diagrams.	
III	**Electronic Spectra of Complexes:** Laporte orbital, selection rules, spin selection rules, Splitting of electronic energy level and spectroscopic states, Interpretation of the spectra of [M (H2O)] in aqueous medium, calculation of Dq, B and B parameters, Jahn Teller distortion and its effect on electronic spectra.	
IV	**Metal-Ligand Bonding & Magnetic Properties of Complexes:** Effects of crystal field splitting, Limitations of CFT, Nephelauxetic series, molecular orbital energy level diagram of octahedral, tetrahedral and square planer complexes; Magnetic Properties of Complexes: Dia, para, ferro and anti-ferromagnetism. Quenching of orbital angular momentum by ligand and magnetic properties of A, E and T terms.	
V	**Metalloenzymes:** Function, structure, bonding and stereochemistry of the active site of Natural dioxygen carriers: Haemoglobin, myoglobin, hemerythrin, hemocyanin; Electron Transport: Iron sulphur protein- Rubredoxin, Ferredoxin, Cytochromes (types a, band c); Redox enzymes: Mocontaining: Nitrogenase, Xanthine oxidase, Sulphite oxidase, Nitrate reductase, Fe containing: Cyt c oxidase, Catalases Peroxidases; Cu containing: Superoxide dismutase (SOD), Bovine superoxide dismutase (BOD), Ascorbic acid oxidase, Zn containing: Carboxypeptidase A & B, Carbonic anhydrase, Urease, Co containing: Vitamin B12, Vitamin Bi, Methyl cobalamime, Biomethylation.	

Suggested Readings:

1. Advanced Inorganic Chemistry, F. A. Cotton and G. Wilkinson, John Wiley
2. Inorganic Chemistry, J. E. Huheey, Ellen A. Keiter, Richard L. Keiter, Addison Wesley Longman (Singapore) Pvt. Ltd.
3. Chemistry of the Elements, N. N. Greenwood and A. Earnshow, Pergamon.
4. Organometallic Chemistry: A Unified Approach, R. C. Mehrotra A. K. Singh, New Age
5. Principles of Organometallic Chemistry, G. E. Coates, M. L. H. Green, P. Powell and K,
6. Principles of Bioinorganic Chemistry, S. J. Lippard and J. M. Berg, University Science Books.
7. Bioinorganic Chemistry, I. Bertini, H. B. Gray, S. J. Lippard and J. S. Valentine, University Science Books.
8. Bioorganic, Bioinorganic and Supramolecular Chemistry, P.S. Kalsi, New Age International (P)Limited.

Suggestive Digital Platforms/ Web Links:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S. No.	Assessment Type	Max. Marks
1	Examinations	10
2	Assignment/ Seminar / Presentation / Quizzes	15

M.Sc. II (SEMESTER-III) PAPER-II		
PROGRAMME: CLASS: M.Sc.	**YEAR: II**	**SEMESTER: III**
SUBJECT: CHEMISTRY		
COURSE CODE: B020902T	**COURSE TITLE:** ***Pericyclic, Photochemistry & Rearrangement Reactions***	

Course outcomes:

- Students will have knowledge to understand of the various pathway of photochemical, pericyclic, rearrangement and name reactions.
- Students will able to design the synthetic routes and mechanisms of targeted molecules.
- Students will focus their aim for future prospects of research in the above area of chemistry.

Credits: 05	**Core**
Max. Marks: 25+75	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
I	**Pericyclic Reactions:** Basic concepts, classifications, characteristics, conservation of Mo symmetry, FO of ethylene, 1-3 butadiene, 1,3,5-hexatriene, allyl system, Woodward, Hoffmann rule for correlation diagram, FMO & PMO approach to study of Electrocyclic reactions of linear conjugated 4n, 4n+2, allyl system: Cycloaddition reaction of [2+2, 14+2) system, [2-2] addition of ketene, 1, 3-dipolar cycloaddition; Simitropic: [1,3], [1,5], 13.3], [5, 5] group transfer reaction suprafacial, antarafacial shift of H, Sigmatropic shift involving carbon moieties, Claisen, Cope rearrangement, Fluxional tautomerism, Aza cope rearrangement, Ene reaction, Chelotropic reaction, Prototropic reaction.	
II	**Photochemistry:** Electronically excited states, spin multiplicity. Jablonski diagram, ISC: Photochemistry of alkenes Geometrical isomerization, cyclisation, dimerization, di-pi methane rearrangement. H abstraction addition, acetylene dimerization, photochemistry of diene, 1,3- butadiene, (2+2) addition leading to cage structure, Photochemistry of Carbonyls. Reduction, Norrish I cleavage of acyclic, cyclic, a, B and B, y unsaturated carbonyl compounds, photochemistry of Norrish II cleavage, Paterno Buchi reaction, intra and inter molecular H abstraction. Rearrangement of a, ß unsaturated ketones, cyclohexadienenes, photoenolization. Photocycloaddition of ketones with unsaturated compound, photodimerisation of (enones), a. B unsaturated ketones, rearrangement of enones, dienones photochemistry of p- beinzoquinones.	
III	**Photochemistry of Aromatics:** Ring isomerization, excited state of benzene and its 12 & 1, 3 shifts, photo Fries rearrangement (of anilide), cyclisation reactions, Skeletal isomerism, Dewar Prismane isomerization of disubstituted benzene, photo substitution reaction of benzene, photolysis of nitride ester.	
IV	**Rearrangements:** Photochemical Rearrangements: Sommlet Hauser, Hofmann-Loffler Freytag, Barson, fries: Molecular Rearrangements: General mechanistic considerations, nature of migration, migratory aptitude, memory effects, a detailed study of the following rearrangements- Wagner- Meerwein. Demjanov Dicone-phenol. Benzil-Benzilic acid, Wolf, Lossen, Beckman, stevens, wittig. Neber, Arndt-Eistert synthesis, Amino ketone, benzidine, Shapiro reaction.	
V	**Selective Name Reactions:** Stark enamine, Chichibebin, Birch reduction, Heck, Suzuki, Mukaiyama, Woodward & Prevost hydroxylation. Peterson synthesis.	

Suggested Readings:

1. Textbook of Pericyclic Reaction, Concept and Application, K.C. Majumdar and P. Biswas, Scientific International Pvt. Ltd..
2. Organic Photochemistry: A visual approach, Jan Kopecky, VCH publishers (1992).
3. Organic Photochemistry, O. Kan, McGraw-Hill Inc., US
4. Organic Chemistry, J. Clayden, N. Greeves, S. Warren and P. Wothers, Oxford,
5. Fundamentals of Photochemistry, K. K. Rohatagi, New Age International (P) Limited.
6. Photochemistry and Pericyclic Reactions, Jagdamba Singh and Jayu Singh, New Age
7. Principles of Molecular Photochemistry, Nicholas J. Turro, V. Ramamurthy J. C., Viva BooksInternational (P) Limited.
8. Organic photochemistry, J. Coxon and B. Halten, Cambridge University Press.
9. Essential of Molecular Chemistry, A. Gilbert and J, Baggot, Blackwell.
10. Molecular photochemistry, N. J. Turro, W. A. Benjamin. Camp, McGraw-Hill
11. Introductory Photochemistry, A. Cox and T.
12. Photochemistry, R. P. Kundalland, A. Gilbert, Thomson Nelson.

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S. No.	Assessment Type	Max. Marks
1	Examinations	10
2	Assignment/ Seminar / Presentation / Quizzes	15

M.Sc. Ii (Semester-Iii) Paper-IV (Elective)		
Programme: Class: M.Sc.	**Year: II**	**Semester: III**
Subject: Chemistry		
Course Code: B020903t	**Course Title: *Electrochemistry***	

Course outcomes: After completion of this course students will able to:

- Understand about electro kinetic phenomenon, Electrolytic conductance, transference and interface: bio electrochemistry, polarography & voltammetry, fuel cells & batteries and conductors & semiconductors.
- Have knowledge about general principles of semi conductivity, semiconductors, fullerenes- conductors, electrochemistry of molten electrolytes and non-aqueous solvents.
- Ideas for further research in the area of electrochemistry.

Credits: 05	**Core**
Max. Marks: 25+75	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
I	**Electro kinetic Phenomenon:** Electro kinetic Effects, Electro kinetic potential/Zeta potentials, Determination of zeta potential, influence of ions on electro kinetic phenomena, Quantitative treatments of Electro-Osmosis, Electrophoretic and Streaming potential, sedimentation potential, The electrical double layer, Theoretical and quantitative treatment of electro kinetic phenomena, Mobility and Bound hydrogen ion..	
II	**Electrolytic Conductance, Transference and Interface:** Debye Huckel theory of strong electrolyte (DHO eqn.), Debye Falkenhagen effect, Wein effect the ionic association, effect of ionic strength on rate of ionic reactions, activity coefficient, ionic strength, its effect on reaction rate, Debye Huckel theory of mean activity coefficient of strong electrolyte (DHLL); Electrolyte interface: Bjerrum theory of ion association in electrolyte solutions, Lippmann equation, determination of surface excess, structure of electrified interface, The Helmholtz -Perin Theory & Guoy-Chapman diffuse charge model of double layer, Stern Modification in the Gouy-Chapman Theory.; Electrodics: The equilibrium exchange current density, Butler Volmer Equation, Tafel plot, high field and low field approximation, Electrodeposition and electro polymerization, Irreversible electrode process: Overvoltage, corrosion (mechanism, corrosion current, corrosion potential, electrochemical corrosion theory, estimation of corrosion rates prevention methods, polarization resistance, electrodeposition. Polarization Resistance	
III	**Electrochemical Cell Reactions:** Galvanic cells, half reactions and reversible electrodes, single electrode potential, thermodynamics of reversible electrodes and cells, Nernst equation, Standard Electrode potential, Electrochemical series, EMF of Galvanic cells; Fuel Cells and Batteries: Fuel cell and its theory, different types of fuel cell, Solid oxide fuel cells (SOFC), Polymer electrolyte fuel cell (PEM), Direct Electrolyte Fuel Cell (DEFC); Super Capacitors: Theory, Measurements and importance; theories of Batteries: Solid state batteries.	
IV	**Polarography and Voltammetry:** Principle of polarography, variations of the conventional polarographic methods, Pulse Polarography, AC polarography, square wave polarography, Anodic stripping and Cyclic voltammetry, Qualitative and quantitative application of polarography, Determination of stoichiometry and formation constants of complexes, Aerometric titrations and advantages.	
V	**Conductors and Semiconductors:** General principles of semi conductivity and semiconductors, Temperature dependence of electrical resistances, Coherent Length, Piezoelectric effect, Piezoelectric and pyroelectric materials, Fullerenes-Doped conductors, Brief idea of Electrochemistry of molten electrolytes and non-aqueous solvents.	

Recommended Books:

1. Modern Electrochemistry, Vol.1&2, J.M. Bockrisand A.K.N Reddy, Plenum.
2. Introduction to electrochemistry, S. Glasston, VanNostrand.
3. Electro-Analytical Chemistry, J. J. Lingane, Willey Inter science.
4. Polarography, D.R. Crow, J. V. Westwood, Methuen and Co.
5. Principle of Polarography, J. Heyrovsky, P. Zuman and L. Kuta
6. Solid state Electrochemistry, Haldil, Academis Press.
7. Electrochemistry of solids, H. Rickett, Springer Book.
8. Ions, Electrodes and Membranes, J. Koryta, Willey and Sons.
9. Electrochemistry, C. W Devis, George Newone, London.
10. Polarography and voltammetry, H.H Bauer & J.E.O Reily.
11. Physical Chemistry, Thomas Engel and Philip Reid, L P E, Pearson Education.
12. Principal of physical chemistry, S.H. Maron and C.F. Prutton, Oxford.
13. Electrode Kinetics, E. Gileadi, VCH Publishers Inc., New York.
14. Electrochemical Methods: Fundamental &applications(2ndEd.), Bard & L. R. Faulkner, John Wiley & Sons, New York
15. Bio electrochemistry: Fundamentals, Experimental Techniques and Applications, P. N. Bartlett, John Wiley & Sons, Ltd

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Examinations	10
2	Assignment/ Seminar / Presentation / Quizzes	15

M.Sc. II (SEMESTER-III) PAPER-IV (ELECTIVE)		
PROGRAMME: CLASS: M.Sc.	**YEAR: II**	**SEMESTER: III**
SUBJECT: CHEMISTRY		
COURSE CODE: B020904T	**COURSE TITLE: Natural Products**	

Course outcomes:

- After completion of this course students will gain knowledge about:
- Isolation and structural determination of various classes of natural products.
- Synthesis and bio synthesis of biomolecules.
- General structure of nucleic acids and configuration & conformation of carbohydrates.

Credits: 05	**Elective**
Max. Marks: 25+75	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
I	**Alkaloids:** General methods of structure elucidation, classification based on N-heterocyclic ring. Degradation, Stereochemistry and synthesis: Nicotine, Quinine, Morphine (Retrosynthesis also), Ephedrine, Reserpine (Retrosynthesis also).	
II	**Terpenoids and Carotenoids:** Classification, General methods of structure elucidation, isoprene rule; structure, stereochemistry, synthesis: Camphor (Retrosynthesis also), Abietic acid, Squalene, Citral, a-Terpenol, Menthol, Farnesol, Santonin, B-Carotene, Longifolenc (Retrosynthesis also).	
III	**Steroids:** Basic skeleton, Diels' hydrocarbon and stereochemistry, structural determination andsynthesis of cholesterol, testosterone, estrone and progesterone.	
IV	**Prostaglandin:** Occurrence, nomenclature, classification, physiological effects and synthesis of PGE: and PGF2	
V	**Proteins:** Amino acids, polypeptide, structure of protein. **Nucleic acids:** General structure of RNA and DNA. **Biosynthesis:** Acetate hypothesis, poly-B-keto acid, meta orientation of hydroxyl group in naturally occurring phenols, biogenesis of fatty acids, mevalonic acid from acetyl coenzyme A. bisynthesis of mono, sesqui, di, tri terpenes, shikimic acid pathway for biosynthesis of aromatic ring, general biosynthesis of alkaloids.	

Suggested Readings:

1. Organic Chemistry, I.L. Finar Vol. I and ELBS.
2. Natural Products: Chemistry and Biological, J. Mann, R.S. Davidson, J.B, Hobbs, D.V.Banthrope and J.B. Harborne, Longman, Essex.
3. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas Ed. Kurt Hostettmann. M.P. Gupta and A. Marston, Harwood Academic publishers.
4. Stereoselective Synthesis: A Practical Approach, M. Nogradi, VCH.
5. Rodds Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Examinations	10
2	Assignment/ Seminar / Presentation / Quizzes	15

M.A./M.Sc. II (SEMESTER-III) PAPER-IV (ELECTIVE)		
PROGRAMME: CLASS: M.Sc.	**YEAR: I**	**SEMESTER: III**
SUBJECT: CHEMISTRY		
COURSE CODE: B020905T	**COURSE TITLE:** MEDICINAL CHEMISTRY	

Course outcomes:

- Students will train about the synthesis. Applications of the various classes of drugs.
- Students will have understanding ot' retrosynthetic analysis thus they can prepare the desired molecules.
- Students will motivate to develop ideas for further research into the medicinal chemistry.

Credits: 05	**Elective**
Max. Marks: 25+75	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
I	**Drugs Design:** Development of new drugs, Structure activity relationship (Structure activity relationship (SAR), Factors affecting bioactivity, Isomerism, bio-isomerism, spatial considerations, Theories of drug activity, Occupancy theory, rate theory, induced fit theory, Quantitative structure activity relationship, History and development of QSAR, concepts of drug receptors (Receptor site theory), elementary treatment of drug receptor interactions, Introduction to combination synthesis in drug discovery, Physico-chemical parameters, Lipophilicity, partition coefficient, electronic ionization constants, steric, Generic medicines.	
II	**Local Anti-infective Drugs:** Antitubercular drugs and antimalarial drugs: Introduction and general mode of action, synthesis of sulphonamides, ciprofloxacin, norfloxacin, dapsone, amino salicylic acid, ethionamide, ethambutol, griseofulvin: 4-aminoquinoline derivatives: chloroquine, santoquine, camoquin, 8- aminoquinoline, primaquine, PAS, Thiosemicarbazones, hydrazides and thiocarbamides.	
III	**Psychoactive Drugs:** CNS depressants, general anesthetics, hypnotics, sedatives, anti-anxiety drugs, benzodiazepines, mental diseases, Antipsychotic drugs. Synthesis of diazepam, alprazolam, trimethadione, barbiturates and glutethimide, Reserpine, Promazine, chlorpromazine, Mepazine.	
IV	**Synthesis of Sulpha Drugs:** Sulphanilamide derivatives, sulphathiazole, sulphadimidine, sulphaguanidine, sulfadiazine; Anti-HIV drug: Crixivan and Cardiovascular Drugs: synthesis of amyl nitrate, hydrolaxime verapamil, methyldopa and diazoxide propanol.	
V	**Structure Based Drugs Classification:** Substituted benzene ring: Chloramphenicol, salmeterol, Tolazamide, dichlophenac, tiapamil, intriptyline; Five membered heterocycles: Tolmetin, Spiralpril, oxaprozine, sulconazole, nizatidine, imolamine, isobuzole; Six membered heterocycles: Warfarin,quinine, norfloxacin, ciprofloxacin, methylclothiazide, citrine, terfenadine; Seven membered heterocyclic ring fused to benzene: Chlordiazepoxide, diazepam, diltiazem; Heterocycles fused to two benzene rings: Quinacrine, tacrine; Five membered heterocycles fused to six membered rings: Acyclovir, methotrexate.	

Suggested Readings:

1. Medicinal Chemistry, D. Sriram, P. Yogeeswari, Pearson Education.
2. Medicinal Chemistry, Ashutosh Kar, New Age International (P) Limited.
3. An Introduction to Medicinal Chemistry, Graham L. Patrick, Oxford University Press.
4. Textbook of Medicinal Chemistry, V. Alagarsamy, Elsevier Health Sciences.
5. The Practice of Medicinal Chemistry, Camille G. Wermuth, Elsevier Health Sciences.
6. Drug-like Properties: Concepts, Structure Design and Methods: From ADME to Toxicity Optimization, Edward H Kerns, Li Di, Elsevier Health Sciences.
7. Ram V. J.; Sethi, A.; Nath, M.; Pratap, R.; (2019), The Chemistry of Heterocycles (Nomenclature and Chemistry of three to five membered Heterocycles), Elsevier publication.
8. Ram V. J.; Sethi, A.; Nath, M.; Pratap, R.; (2019), The Chemistry of Heterocycles (Chemistry of six to eight membered N, O, S, P and Se heterocycles), Elsevier publication
9. A. Burger; Medicinal Chemistry.

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Examinatons	10
2	Assignment/ Seminar / Presentation / Quizzes	15

M.A./M.Sc. FINAL (SEMESTER-III) PAPER (PRACITAL)		
PROGRAMME: CLASS: M.Sc.	**YEAR: II**	**SEMESTER: III**
SUBJECT: CHEMISTRY		
COURSE CODE: B020906P	**COURSE TITLE:** CHEMISTRY LABORATROY COURSE-IIIA	

Course outcomes: After completion of this course students will acquire the knowledge of:

- Synthesis of inorganic compounds in organic and aqueous medium.
- Calorimetry, spectrophotometry and flame photometry estimation of metals in solution/ water,
- Qualitative analysis of ternary organic mixtures and three steps organic preparations.
- Interpretation of the spectral data of inorganic and organic compounds.
- Various theories and principles behind the experiments of physical chemistry viz. potentiometry and conductometry.

Credits: 05	**Elective**
Max. Marks: 50+50	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
	Part I	
I	**INORGANIC CHEMISTRY** **Inorganic preparation in aqueous and organic medium:** i. Preparation of K3[Fe(C2O4)3].3H2O ii. ii. Preparation and separation of cis and trans-[$Co(en)Cl_2$] iii. Preparation of CuCl2 DMSO and Copper glycine complex. iv. Preparation of Ph3P and its complexes. v. Preparation of ferrocene. vi. Preparation of Mn(gly)3 **Spectroscopy:** Record the spectra (UV, IR & Mass) and analyze the spectral data of the synthesized inorganic complex compounds. **Calorimetry and Spectrophotometry:** i. Estimation of the metals in solution V, Mo, and Fe Calorimetry /Spectrophotometry. ii. Colorimetric and Spectrophotometric analysis: Determination of iron, copper, ammonium, phosphate, fluoride and nitrite ions. iii. To verify Lambert's Beer Law calorimetrically/ spectrophotometrically of inorganic compounds. **Flame Photometry:** i. Estimation of magnesium and calcium in tap water ii. Estimation of calcium in calcium salt solution.	
II	**ORGANIC CHEMISTRY** **Qualitative Analysis:** Separation purification and identification of components of ternary organic mixtures (all liquids, two liquids & one solid, all solids). Each component should not contain more than two functional groups. The student should check the purity by TLC, systematic analysis of each component leading to their final identification laying emphasis on solubility, element detection, melting point, boiling point determination, ignition test, unsaturation test, functional group test and preparation of suitable derivative. **Organic Synthesis:** Three step synthesis of organic compounds. **Spectroscopy:** Record the spectra (UV, IR, 'H NMR, 13C-NMR and Mass) and analyze the spectral data of synthesized organic compounds.	
III	PHYSICAL CHEMISTRY **Potentiometry:** i. Determination of the solubility of a sparingly soluble salt in water by EMF method. ii. Titration of ferrous ammonium sulphate against K2Cr2O7 (or KMnO4) potentiometrically and determine the formal redox potential of Fe-Fe system. iii. Find out the normality of the given HCl solution by titrating it potentiometrically with N/15 NaOH solution.. **Conductometry:** i. Determination of the strength of strong acid conductometrically by using strong alkali solution. ii. Determination of the strength of weak acid conductometrically by using strong alkali solution. iii. Determination of cell constant of the conductivity meter with the help of KCl solution.	
	System of Marking:- Time: 12h Physical: 33	

	Inorganic: 33 Organic: 34	
	Recommended Book: 1. Experimental Inorganic Chemistry by Mounir A, Malati, Horwood series in Chemical Science (Horwood publishing Chichester) 1999. 2. Inorganic Experiments, J. Derexwoolings VCH 3. Practical Inorganic Chemistry, G. Marrand, B.W. Rockett, Van Nostrand. 4. Synthesis and characterization of Inorganic compounds, W.L. Jolly, Prentice Hall 5. The systematic Identification of Organic Compounds, R.L. Shringer and D.Y. Curlin. 6. Handbook of Organic Analysis Qualitative and Quantitative, H. Clark, Adward Ar. 7. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley. 8. Systematic Qualitative Organic Analysis, H. Middeton, Adward Arnoid. 9. Practical Physical Chemistry, A.M. James and F.E. Prichand, Longman. 10. Findley's Practical Physical Chemistry revised, B.P. Levitt, Longman. 11. Experimental Physical Chemistry, R.C. Das and Bebera, Tata Mc Grawhill.. 12. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Barg (R. Chand and Co., Delhi) 13. Experimental Physical Chemistry by D.P. Shoemaker Mc Grawhill, 7th Edition 2003. 14. Systematic Experiment in chemistry, Arun Sethi, New Age International (P) Limited. 15. Practical Physical Chemistry, B. Vishwanathan and P. S. Raghwan, Viva Books. 16. Experimental Physical Chemistry, V. D. Athawale, Parul Mathur, New Age International (P) Limited. 17. Experiments in Physical chemistry, J.C. Ghosh, Bharati Bhavan. 18. Advanced Practical Physical Chemistry, JB Yadav.	

M.A./M.Sc. FINAL (SEMESTER-III) PAPER (PRACITAL)		
PROGRAMME: CLASS: M.Sc.	**YEAR: II**	**SEMESTER: III**
SUBJECT: CHEMISTRY		
COURSE CODE: B020907P	**COURSE TITLE:** CHEMISTRY LABORATROY COURSE-III B	

Course outcomes: After completion of this course students will acquire the knowledge of:

- Quantitative estimation of the complex mixtures containing two or three constituents and analysis of alloys and minerals.
- Chromatographic separations of ions by using suitable ion exchangers.
- Estimations of functional groups and element present in the organic compounds.
- Extraction of biomolecules from natural sources.
- Various theories and principles behind the experiment of Ph-metry and spectrophotometry.

Credits: 05	**Elective**
Max. Marks: 50+50	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
	Part I	
I	**INORGANIC CHEMISTRY** **Gravimetric Estimations:** Gravimetric estimations of complex mixtures involving two or three constituents, Analysis of alloys and minerals. **Volumetric Estimations:** i. EDTA titrations - Determination of Zn, Ca, Mg and Fe. ii. KBrO3 and KIO3 titrations -Determination of As2O3 and [Fe(CN)6]. iii. Chloramine T-titrations - Determination of NO2 in a sample. iv. Ceric Ammonium Sulphate titrations - Determination of Fe and organic acids. **Chromatography:** i. Separation of CI and Br by suitable ion exchangers ii. Separation of Co2+ and Ni2+ by suitable ion exchangers iii. Separation of Zn2+ and Mn2+ by suitable ion exchangers	
II	**ORGANIC CHEMISTRY** **Quantitative Analysis:** i. Determination of percentage or number of hydroxyl group in an organic compound by acetylation method. ii. Determination of percentage or number of amino groups in an organic compound by acetylation method. iii. Determination of percentage or number of methoxy group in the organic compound by Ziesel's method. iv. Estimation of amines/phenols using bromate bromide solution/or acetylation method. v. Determination of iodine and saponification value of an oil sample. vi. Estimation of Nitrogen in the organic compound by Kjeldahl's method. vii. Estimation of sulphur in the organic compound by Messenger's method. Extraction: Isolation of biomolecules from natural sources.	
III	**PHYSICAL CHEMISTRY** **p^H-metry:** i. Determination of the strength of strong acid with strong base by using p" meter. ii. Determination of the strength of weak acid with strong base by using pH meter. iii. Verification of Henderson's equation by using pH meter. **Spectrophotometry:** i. Estimation of the following metals in solution Cr and Ni. ii. Determination of stability constant of a metal ligand complex by spectrophotometric method. iii. Investigation of reaction between potassium per-sulphate and potassium iodide by spectrophotometer method. iv. To verify Lambert's Beer Law spectrophotometric ally.	
IV	**System of Marking:-** Time: 12h Physical: 33 Inorganic: 33 Organic: 34	

	Recommended Books: 1. Vogels Text book of Quantitative Analysis revised, J. Bessett, R.C. Denney, G.H. Jellery and J. Mendhan ELBS 2. Experimental Inorganic Chemistry by Mounir A, Malati, Horwood series in Chemical Science (Horwood publishing Chichester) 1999. 3. Inorganic Experiments, J. Derexwoolings VCH 4. Practical Inorganic Chemistry, G. Marrand, B.W. Rockett, Van Nostrand. 5. Handbook of Organic Analysis Qualitative and Quantitative, H. Clark, Adward Ar 6. Systematic Experiment in chemistry, ArunSethi, New Age International (P) Limited. 7. Practical Organic Chemistry, Mann and Saunders. 8. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley. 9. Practical Physical Chemistry, A.M. James and F.E. Prichand, Longman. 10. Findley's Practical Physical Chemistry revised, B.P. Levitt, Longman. 11. Experimental Physical Chemistry, R.C. Das and Bebera, Tata Mc Grawhill. 12. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Barg (R. Chand and Co., Delhi) 13. Experimental Physical Chemistry by D.P. Shoemaker Mc Grawhill, 7th Edition 2003. 14. Experiments in Chemistry, D.V. Jahagirdar, Himalaya Publishing House. 15. Practical Physical Chemistry, B. Vishwanathan and P.S. Raghwan, Viva Books. 16. General Chemistry Experiments, Anil J Elias, University Press (2002) 17. Experimental Physical Chemistry, V.D. Athawale, ParulMathur, New Age 18. International (P) Limited. 19. Advanced Practical Physical Chemistry, JB Yadav. 20. Experiments in Physical chemistry, J.C. Ghosh, Bharati Bhavan. Practical Organic Chemistry, Mann and Saunders.	

M.Sc. II (SEMESTER-IV) PAPER-I
Title: Organ transition Metal Chemistry

Programme: Class: M.Sc. Final	Year: II	Semester: IV
Subject: Chemistry		
Course Code: B021001	Course Title: ***Organ transition Metal Chemistry***	

Course outcomes: After completion of this course students will be able to:
CO-1: Understand detailed about metal carbonyls & organ transition metal complexes having M-C & M-H bonds.
CO-2: Acquire understanding of organ transition metal complex having л acids ligands.
CO-3. Have understanding of organometallic catalysts, macrocyclic complex and fluxional organometallic compounds.
CO-4. Develop idea for further research in the field of organ transition metal chemistry,

Credits: 05	Core
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
I	**Metal Carbonyls:** Preparation, Structure and reactions/ properties of mononuclear and polynuclear metal carbonyls, Nature of M-CO bonding. Vibrational spectra of metal carbonyl, Principal reaction types, Verities of CO bridging; Metal nitrosyls: bonding, structure, Metal carbonyl-metal nitrosyl complex: Carbonyl metal hydride. vibrational spectra of metal carbonyls for structural elucidation.	
II	**Organometallics:** Nomenclature, general characteristics, Major types of transition metal to carbon bonds, Preparation stability and important reaction of transition metal alkyl and aryls; Inorganic n- Acid ligands: O, N, tertiary phosphine and arsines as ligands; Complexes of o-donor ligands: General methods of preparation, properties, nature of bonding and structural features of Transition metal alkenyls, alkynyls and carbines, carbines & Pi Complexes of unsaturated molecules: alkenes, alkynes, allyl, dienes, dienyl cyclopentadienyl, thenyl (arenes) complexes, Important reactions related to nucleophilic and electrophilic attack on ligands, reactions, with special reference to organic synthesis; Transition Metal compounds with M-H bond: Metal hydrides (Classical, non- classical), synthesis and important reactions; Metal alkoxides: Preparation, Properties, Structure, Industrial application.	
III	**Organometallic Catalyst:** General ideal of important catalytic steps, ligands coordination, and dissociation, and elimination, nucleophilic attack on coordinated ligands & coordinated molecular oxygen, Template synthesis, Oxidative addition, Reductive elimination and migration (insertion) reactions; Homogeneous Catalysis: Hydrogenation of alkenes using Wilkinson's catalyst, Hydroformylation of alkenes using Co and Rh catalysts, Carbonylation of methanol to acetic acid (Monsanto process), Oxidation of alkenes (Wacker process).	
IV	**Metal Clusters & Micro-Macrocyclic Complex:** M-M multiple bonds containing binuclear, trinuclear, tetranuclear and octahedral clusters, synthesis and bonding in clusters, metal carbonyl halides, Chalcogenide clusters; Types of macrocyclic ligands, design and synthesis by coordination template effect, di and polynuclear macrocyclic complexes, Application of macrocyclic complexes.	
V	**Fluxional Organometallic Compounds:** Fluxionality and dynamic equilibria in compounds such as 2-olefine, a allyl and dienyl complexes; Organometallic Compounds of Lanthanides and Actinides: Methods of preparation, properties and structural features.	

Suggested Readings

1. Advanced Inorganic Chemistry, F. A. Cotton and G. Wilkinson, John Wiley
2. Inorganic Chemistry, J. E. Huheey, Ellen A. Keiter, Richard L. Keiter, Addison Wesley
Longman (Singapore) Pvt. Ltd.
3. Chemistry of the Elements, N. N. Greenwood and A. Earnshow, Pergamon.
4. Organometallic Chemistry: A Unified Approach, R. C. Mehrotra and A. K. Singh, New Age
5. Principles of Organometallic Chemistry, G. E. Coates, M. L. H. Green, P. Powell and K. Wade, Chapman and Hall, London.
6. Comprehensive Organometallic Chemistry, Ed. E.W. Abel, Abel, F.G.A. Stone and G. Wilkinson, Pergamon.

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S. No.	Assessment Type	Max. Marks
1	Examinations	10
2	Assignment/ Seminar / Presentation / Quizzes	15

M.A./M.Sc. II (SEMESTER-IV) PAPER-II
Title: Organic Synthesis

Programme: Class: M.Sc. Final	Year: II	Semester: IV
Subject: Chemistry		
Course Code: B021002T	Course Title: *Organic Synthesis*	

Course outcomes: CO-1. Students will train about the handling and applications of reagents in organic synthesis. CO-2. Students will able to understand designing and synthesis of targeted molecules by applying retrosynthetic approach. CO-3. Students will train to develop ideas for further research in the field of synthetic organic chemistry.

Credits: 05	Core
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
I	**Oxidation & Reduction:** Different oxidative processes, Hydrocarbon alkenes, aromatic ring, saturated C-H groups (activated and inactivated) Alcohols, diols, aldehydes, ketones, carboxylic acids, amines, hydrazine, supplied; Reduction: Different reductive process, Hydrocarbon-alkanes, alkenes, alkynes, aromatic rings, carbonyls-aldehyde, ketones, acids, acid derivatives, epoxides, hydrogenolysis.	
II	**Reagents:** LIAIH4, NaBH4, SnBu3H, RhCI(PPh)3, IC6H5(OAc)2, SeO2, RuO4, OSO4, RCO3H, HIO4, Pb(OAc)4, CH2N2, NBS, R_2CuLi, LDA, DCC, 1,3-dithiane (reactivity umpolung), Me,SI, Baker's yeast, organophosphorus compounds, ylides (S, N, P), Phase transfer catalyst, quaternary ammonium and phosphonium salts, crown ethers, Merrifield resins, DDQ, Jone's reagent, TI(NO3)3, DIBAL, B2H6, di-isoamylborane, 9-BBN.	
III	**Asymmetric Synthesis:** Stereospecific, stereo selective synthesis, Enzymatic and catalytic nexus, Enantioselective synthesis with chiral non racemic and catalysts, hydroboration with chiral boranes (IPCBH2). (APC)21 BH, carbonyl group reductions and chiral complex hydride (BINAL-H). Chiral oxazaberlidines, Diastereoselective synthesis, Asymmetric synthesis involving chiral, auxiliary chiral reagent and chiral catalysis, methods of resolution, enantiomeric excess i.e., quasi race mate and optical purity.	
IV	**Retrosynthetic Analysis:** Synthon, synthetic equivalent, one group C-X and two group C-X disconnection, Disconnection (C-C, C-S, C-O) bonds, FGI, Chemo selectivity, Cyclisation reactions, synthetic strategy for formation of C-C, C-N, C-X bonds. Reversal of polarity, Amine synthesis, multistep synthesis; Protection: Principles, DE protection of alcohols, thiols, 1,2 and 1,3- diols, amines, carbonyls and carboxyl groups in organic synthesis.	
V	**Synthesis of Some Complex Molecules and Green Chemistry:** Application of the above in the synthesis of following compounds: Camphor, Longifolene, Cortisone, Reserpine, Vitamin D, Juvabione, Aphidicolin and Fredericamysin A; Green Chemistry: Basic Principle, Microwave assisted organic synthesis, Combinatorial chemistry.	

Suggested Readings

1. H.O. House, Synthetic Organic Chemistry, Benjamin-Cummings Publishing Co.
2. Organic Chemistry J. Clayden, N. Greeves, S. Warren and P. Wothers, Oxford Press.
3. Organic Synthesis, Pragati Edition, Jagdamba Singh and L.D.S Yadav.
4. Some modern methods of organic synthesis, W. Carruthers, Cambridge University Press.
5. Organic Reactions and Their Mechanisms, P. S. Kalsi, New Age Science. 6. Workbook for Organic Synthesis, Stuart Warren, John Wiley & Sons.
7. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons.
8. Ram V. J.; Sethi, A.; Nath, M.; Pratap, R.; (2019), The Chemistry of Heterocycles (Nomenclature and Chemistry of three to five membered Heterocycles), Elsevier publication.
9. Ram V. J.; Sethi, A.; Nath, M.; Pratap, R.; (2019), The Chemistry of Heterocycles (Chemistry of six to eight membered N, O, S, P and Se heterocycles), Elsevier publication.

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S. No.	Assessment Type	Max. Marks
1	Examinations	10
2	Assignment/ Seminar / Presentation / Quizzes	15

M.Sc. II (SEMESTER-IV) PAPER-III (Elective)
Title: Analytical Chemistry

Programme: Class: M.Sc. Final	**Year: II**	**Semester: IV**
Subject: Chemistry		
Course Code: B021003T	**Course Title:** Analytical Chemistry	

Course outcomes: After completion of this course:
CO-1: Student will be able to know the basic concept involved in the analytical chemistry.
CO-2: Students will gain the understanding of data analysis, electroanalytical, thermo analytical, Spectro analytical and spectral techniques which is frequently involved in various research areas.

Credits: 05	**Elective**
Max. Marks: 25+75	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
I	**Data Analysis:** Systematic and random errors, Accuracy and Precision and ways of its expression, Fitting data to a straight line, Normal error curve and its equation, Propagation of errors, Standard tests, Test of significance, F-test, Student t test, Q-test, Chi- test, Correlation test, distribution normalcy test, confidence limit of mean, comparison of two standard value, comparison of standard deviation and average deviation, comparison of mean with true value, significant figures, Rounding of figures, Regression analysis (least square method for linear plots), Rejection of observations, Statistics of sampling and detection limit evaluation.	
II	**Electroanalytical Techniques:** Conductometry, Polarography (Limiting current density, Dropping mercury electrode, Ilkovic equation, Half wave potential), Voltammetry, Cyclic voltammetry, Anodic stripping voltammetry, Potentiometry, Amperometry, Ion selective electrodes, Coulometry.	
III	**Thermoanalytical Techniques:** Apparatus, factors affecting TG, Interpretation of TG curves of CaCO..H_2O and MgC2042H2O. Apparatus, factors affecting DTA and DSC curves with special reference to heating rate, particle size and packing, measurement of heat of transition, heat of reaction and heat of dehydration of salts and metal hydrates.	
IV	**Spectroanalytical Techniques:** Elementary idea of nephleometry and Turbidimetry.	
V	**Separation Techniques:** Distribution law: Principles and application of solvent extraction, Chromatography: Column, ion exchange and size exclusion chromatography. GLC, GSC, HPLC, electrophoresis.	

Suggested Readings

1. Lloyd R. Snyder LC Resources, Inc. walnut Greek, California
2. Colin F. Poole, Department of Chemistry, Wayne State University Detroit MI 48202, USA 2003, Elsevier.
3. J. D. Seader, and Ernest J. Henley, Separation Process Principles, Wiley, 2nd edition (2013).
4. Fundamentals of analytical Chemistry, D. A. Skoog, D. M. West and F. J. Holler.
5. Analytical Chemistry, Theory practice, U.N. Das, Sultan Chand and Sons, New Delhi.

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	Assessment Type	Max. Marks
1	Examinatons	10
2	Assignment/ Seminar / Presentation / Quizzes	15

M.Sc. II (SEMESTER-IV) PAPER-IV (Elective)
Title: Polymer Chemistry

Programme : Class: M.Sc. Final	**Year: II**	**Semester: IV**
Subject: Chemistry		
Course Code: B021004T	**Course Title:** Polymer Chemistry	

Course outcomes: After completion of this course students will be able to: CO-1. Have knowledge about the basic concepts and principles of polymers. CO-2. Understand about polymer chemistry- characterization, polymerization, and kinetics of polymerizations, degradation, rheology and processing. CO-3. Develop ideas for further research in the area of polymer chemistry.

Credits: 05	**Core**
Max. Marks: 25+75	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	**Topics**	**No. of Lectures**
I	**Basic Concept & Polymer Characterization:** General definition, Monomers, repeating units, degree of polymerization, Types and Classification of polymers, Concept of average molecular weights in polymers: (Number average, Weight average, Viscosity average and Sedimentation average molecular weights), Concepts of Mono-dispersity, poly-dispersity, Significance of Molecular Weight, Distribution Curves of polymers, The practical significance of molecular weight; Measurement of molecular weights: End-group, viscosity, light scattering, osmotic and ultracentrifugation methods.	
II	**Kinetics & Mechanism of Polymerization:** Polymerization conditions and polymer reactions, Polymerization in homogeneous and heterogeneous systems, Kinetics and mechanism of condensation, Addition (Radical chain and Ionic chain), Coordination and Copolymerization.	
III	**Rheology & Degradation: Rheology:** Viscous flow (Newtonian and Non- Newtonian fluids), Rubber elasticity (thermodynamic and entropy, elasticity), Visco-elasticity, The glassy state and glass transition temperature; Degradation: Types of degradation: Random degradation and Chain depolymerisation, A general idea of thermal, mechanical and oxidative degradation, Antioxidants and stabilizers.	
IV	**Polymer Processing:** Plastics, elastomers and fibers, Compounding, Processing techniques: Calendaring, die casting, rotational casting, film casting, Injection moldings, blow moulding, extrusion moulding, thermoforming & thermoforming, reinforcing and fiber spinning.	
V	**Properties of Commercial Polymers:** Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers; Functional polymers: Fire retarding pclymers and electrically conducting polymers; Biomedical polymers: contact lens, dental polymers, artificial heart, kidney, skin and blood cells; Light emitting polymers: Elementary idea of light emitting polymers.	

Suggested Readings

1. Textbooks of Polymer science, F.W. Billmeyer, Jr. Wiley.
2. Polymer Science, U.R. Gowariker, N.V. Vishwanathan and J. Sreedhar, Wiley-Estern.
3. Functional Monomers and Polymers, K. Takemoto, Y.Inaki and R.M. Ottanbrite.
4. Contemporary Polymer Chemistry, H. R. Allcock and F.W. Lambe, Prentice hall.
5. Physics and Chemistry of Polymers, J.M.G. Cowie, Blackie Academic and Professional.

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	**Assessment Type**	**Max. Marks**
1	Examinations	10
2	Assignment/ Seminar / Presentation / Quizzes	15

M.Sc. II (SEMESTER-IV) PAPER-V (Practical)
Title: Practical Based Major Research Project/Dissertation

Programme: Class: M.Sc. Final	**Year: II**	**Semester: IV**
Subject: Chemistry		
Course Code: B021001P	**Course Title: *Practical Based Major Research Project/Dissertation***	

Course outcomes:
CO-1. After completing this major research project/dissertation, students will learn to work independently.
CO-2. Students will be able to plan and strategize a scientific problem, and implement it within a reasonable time frame.
CO-3. Students will be able to know the library search and to interpret the spectral data independently.
CO-4. Students will be able to critically examine research articles, and will improve their scientific writing as well as communication skills.
CO-5. Students will be able to present their finding by using OHP/PPT.

Credits: 10	**Core**
Max. Marks: 50+50	**Min. Passing Marks:**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	**Topics**	**No. of Lectures**
	For major research project work/dissertation, the area of the work would be decided by the advisor/mentor/HOD. On completion of the major research project work/dissertation, students have to submit the work in the form of a dissertation followed by oral presentation in the presence of faculty members and finally it will be evaluated by internal and external examiners followed by conducting viva voce examination.	

Suggested Readings

Suggestive Digital Platforms/ Web Links:

This course can be opted as an elective by the students of the following subjects:

Suggested Continuous Evaluation Methods (Max. Marks: 25)

S.No.	**Assessment Type**	**Max. Marks**
1	Examinations	10
2	Assignment/ Seminar / Presentation / Quizzes	15