Name of Program	**Master of Science**
Abbreviation	**M.Sc.**
Duration	**2 Years**
Eligibility criteria	**M.Sc. (Organic chemistry)** Eligibility: A candidate who has obtained his/her bachelor's degree in chemistry shall be considered eligible for admission to M.Sc. Chemistry/ Organic chemistry
Objective of program	The core objective of the M.Sc. program is to prepare the students for a dynamic career in industry and academia by providing an excellent teaching and research environment in the core and emerging areas of the discipline.
Program outcome	**PO1:** To enhance the knowledge of chemistry domains and become a master in the respective branch of chemistry. To be able to communicate clearly and effectively within and across disciplinary lines. **PO2:** Built-up entrepreneurship ability by taking advantage of the industrial hub in the periphery of our university. **PO3:** Establishment of a research center with the aid of interdisciplinary subjects being run in the university. **PO4:** Persuasion of a doctoral degree in the concerned subject and further study. **PO5:** Development of related short-term courses related to the demanded subject in anticipation of strengthening knowledge and application **PO6:** Training/internship of students for employment in the public sector, private sector, and national laboratories. **PO7:** Participation in scientific discussions showing respect and leading interdisciplinary work with experts from other fields. **PO8:** To understand and adopt the best safety practices in chemical research. **PO9:** Participation in scientific discussions showing respect and leading interdisciplinary work with experts from other fields. **PO10:** To understand and adopt the best safety practices in research

Name of Program	**Master of Science**
Abbreviation	**M.Sc.**
Duration	**2 Years**
Eligibility criteria	**M.Sc. (Organic chemistry)** Eligibility: A candidate who has obtained his/her Bachelor's Degree in chemistry shall be considered eligible for admission to M.Sc Chemistry/ Organic chemistry
Objective of program	The core objective of the M.Sc. program is to prepare the students for a dynamic career in industry and academia by providing an excellent teaching and research environment in the core and emerging areas of the discipline.
Program outcome	Students need to build up the foundation in the fundamentals & application of current chemical and scientific theories in the concerned branches of Inorganic, Organic, Analytical, Physical, Environmental, and Pharmaceutical Chemistry. **PSO1:** Develop a scientific temper, and communicate scientific information in a clear, concise, and precise manner. **PSO2**: Find job opportunities at all levels of chemical industries(dyes & pharmaceutical), national laboratories & research centers. **PSO3:** Apply the knowledge in sustainable and eco-friendly technologies. **PSO4:** Inculcate logical thinking to address the problems and become result oriented. **PSO5:** Development of research culture in the persuasion of the Ph.D. program at national & international institutes/universities. **PSO6:** Participate in the specific competitive examination conducted by various public service commissions and other public sector. **PSO7:** Develop and apply the fundamental knowledge to build a small-scale industry in the context of Atama Nir Bhar Bharat. **PSO8:** Scale up the synthetic product to a pilot-level plant and gradually to bulk. **PSO9:** Enhance the scientific temperament among the students in anticipation of developing a research culture and implementation of policies at the global & local levels. **PSO10:** Communicate scientific information clearly in both writing and orally. **PSO11:** Students shall start to become better readers, thinkers, and learners in their discipline by processing their ideas through writing. **PSO12:** This will build new scientific understanding as it provides students the opportunity to articulate their thinking as they engage in science practices during an investigation.

Structure of M.Sc. Syllabus

Semester-I

Sr. No.	Course Code	Course Title	L	T/C/D	Credit
1	MSC1C101	Inorganic Chemistry	4		4
2	MSC1C102	Organic Chemistry	4		4
3	MSC1C103	Physical Chemistry	4		4
4	MSC1C104	Analytical Chemistry	4		4
5			12	3	6+3
Total			28	3	25

Faculty code: Science **Subject code:**

Level Code:

Name of program: M.Sc. **Subject: Chemistry**

External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No.	Course group	Credit	Internal marks	External marks	Total marks
M.SC.	I	I	Core	04	30	70	100
		II	Core	04	30	70	100
		III	Core	04	30	70	100
		IV	Core	04	30	70	100
		-	Practical+ T/C/S	06+3	60	140	200
		Total		25	180	420	600

M.Sc. Inorganic Chemistry, Semester – I

Course Code	Title of the Course	Title Credits of Course	Hours Per Week
MSC1C101	INORGANIC CHEMISTRY	4	4hrs

Course Objectives	• To understand concept of symmetry and group theory with its application. • To understand basics of Quantum mechanics, familiarize with various types of operators and implant the knowledge of orbital configuration • To learn the inorganic reaction mechanism. Different types of reaction mechanism and also various types of transition state theory • Understanding of concepts of metal cluster, classification of metal clusters, Wade's rule, Carboranes, low and high nuclearity carbonyl clusters.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**Quantum theory and Atomic Structure** Postulates of quantum mechanics, setting up of different observables, eigen value of angular momenta and commutation relations, step-up and step-down operators, angular momenta in many electron atoms. Schrodinger wave equation and applications: particle on a ring and the simple harmonic oscillator. H-atom wave functions, solutions of R(r) $\theta(\theta)$ and $\phi(\varphi)$ equations, quantum numbers, angular and radial wave function, shapes of the orbitals, angular momentum of inner quantum number j, physical interpretation of hydrogenic orbitals; space quantization of electronic orbits; electron spin. Approximation methods: Variation method and application to H atom. Perturbation theory (first order and non-degenerate, application to the Helium atom	25%
2.	**Symmetry and Group** Theory Representation of groups –some properties of matrices & vectors, representation of groups, the Great orthogonality theorem and its consequences, character table, wave functions as basis for irreducible representations, direct product, identifying nonzero matrix elements.	25%
3.	**Magnetochemistry** Magnetic susceptibility and basic derivation of diamagnetic susceptibility, pascal constant and its utility, Curie law and Curie-Weiss law, anti-ferromagnetism and ferromagnetism. Types of anti-ferromagnetism, anti-ferromagnetic exchange pathway : Direct –metal- metal interaction and Indirect-atom exchange i.e. super exchange mechanism.	25%
4.	**Bio-inorganic Chemistry** Metalloporphyrin's (enzymes) definition, haemoglobin and myoglobin, cytochrome, vitamin B_{12} (cyano cobalamin), zinc-metallo enzymes, nitrogen fixation, essential and trace elements in biological system, biochemistry of non-metals K, Na pump (action of bath ions), toxic metals and their toxicity. Co-ordination compounds in medicine Chelation therapy, gold compounds and rheumatoid arthritis, anticancer drugs –platinum complexes, gold complexes, metallocene etc, antimicrobial agents, metal complexes as radio	25%

	diagnostic agents, magnetic resonance imaging.	

Teaching Methodology	To meet the effective teaching and the learning requirements, teachinglearning methodology comprise classroom teaching, use of e-resources, library books , IT tools, encouraging students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation of pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn regarding quantum mechanics, angular momentum, understanding the solution of Schrodinger equation, Different types of operators and their uses
2.	Understand the of matrices and vectors matrix notations, reducible representation and their relation, applications of group theory
3.	Understand the definitions of magnetic properties, type of magnetic bodies, determination of magnetic susceptibility and its applications.

Suggested References:

1. Introduction to Quantum Chemistry, A. K. Chandra, Tata MacGraw Hill
2. Quantum Chemistry, Ira N. Levine, Prentice Hall.
3. Quantum Chemistry by R. K. Prasad, New Age International Publishers (1985).
4. Elementary Quantum Chemistry by D. L. Pilar, Mc Graw Hill Book Co, New York (1968).
5. D. A. McQuarrie Quantum Chemistry, OUP 1983.
6. M. W. Hanna, Quantum Mechanics in Chemistry, The Benjamin Pub.
7. Molecular Quantum Mechanics, Third Edition, P. W. Atkins and R.S. Friedman.
8. Group theory and symmetry in chemistry, L. H. Hall(McGraw Hill).
9. F. A. Cotton, Chemical Applications of Group theory, Wiley Eastern 2nd Edn.1992.
10. V. Ramkrishnan & M. S. Gopinadhan, Group theory in Chemistry Vishal Pub.1996.
11. Inorganic Chemistry, Third Edition, Alan G. Sharpe.
12. Theoretical Inorganic Chemistry, M. C. Day, J. Shellin.
13. Chemistry, Fifth Edition, John E. McMurry, Robert C. Fay.
14. Hermann Dugas, Bioorganic Chemistry, A Chemical Approach to Enzyme Action, Springer International Edition.
15. An Introduction to Theoretical Chemistry, Jack Simons, Cambridge.
16. Progress in inorganic Chemistry, Vols 18 and 38 ed. J. J. Lippard, Wiley.
17. Inorganic Reaction Mechanisms, M. L. Tobe, Nelson Pub.
18. Inorganic Chemistry, K. F. Purcell and J. C. Kotz.
19. Principles of Bioinorganic Chemistry, S. J. Lippard and J. M. Bers.
20. Bioinorganic Chemistry, I. Bertini, H. B. Gray and S. J. Lippard.
21. Principals of Biooganic Chemistry, S. J. Lippard and J. M. Berg, University Science Books.

22. Bioinorganic Chemistry, I. Bertini, H. B. Gray, S. J. Lippard and J. S. Valentine, University Science Books.
23. Inorganic Biochemistry vols I and II ed. G. L. Eichhorn, Elsevier.
24. Introduction to Magnetochemistry, Alan Earnshaw, 1968.
25. Elements of Magnetochemistry, Dutta and Syamal, 1993

On-line resources to be used if available as reference material.

Master of Science, Inorganic Chemistry Practical, Semester-I

Course Code	Title of the Course	Title Credits of Course	Hours Per Week
MSC1P101	INORGANIC CHEMISTRY PRACTICALS	4	4hrs

Course Objectives	• To impart basic knowledge of qualitative analysis of Inorganic mixture • To identify three anions and three cations including one rare earth element by group separation. • To impart knowledge of different radicals by confirmative test. • Preparation of inorganic metal salts and it's crystallization • To confirm the structure and prepare the relevant derivative.

Course Content	
1.	Semi-micro qualitative analysis of 15 mixtures, each having six radicals including less familiar elements (Mo, W, Li, Th, V, Zr, Ce, Be, Ti) and one insoluble compounds.

Teaching-Learning Methodology	Introduction, demonstration of handling equipment, reference books and frequent instruction according to the respective practical.

Evaluation of pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand basics analysis of Inorganic mixtures.
2.	Identify anions by dry test of the mixture.
3.	Separation of each anions by group test from mixture.

Suggested References:

1. Vogel's Qualitative Inorganic Analysis, Revised by G Svehla, Sixth Edition, Longman, 1987

M.Sc. Organic Chemistry, Semester – I

Course Code	Title of the Course	Title Credits of Course	Hours Per Week
MSC1C101	**ORGANIC CHEMISTRY**	**4**	**4hrs**

Course Objectives	• To understand the concept of reactive intermediate and their application in organic synthesis. • To learn aromaticity based on different concept, measurement of aromaticity through various parameters, annulenes, azzulene and types of aromaticity. • To learn anchimeric assistance, stereo chemistry and internal substitution reaction of aliphatic and allylic compounds. Aromatic nucleophilic substitution, cine substitution, elimination reactions, their stereo chemistry and mechanisms. • Understanding of concepts of chirality, topicity, prochirality, dynamic resolutions, types of stereo selective and stereo specific reactions, conformation of substituted and fused aromatic rings along with respective strains theories.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**A. Elimination Reaction** The E1, E2, E1CB mechanism, stereochemistry. Orientation of the double bond syn and anti-eliminations. Reactivity- effects of substrate structures, attacking base, leaving group and medium. Mechanism and orientation in pyrolytic syn eliminations– Chugaev, Cope eliminations and Burgess dehydration reaction. **B. Nucleophilic Substitution Reaction** Mixed SN1, SN2 and SET mechanism. Nucleophilic substitution at (a) Allylic carbon (Allylic rearrangements), (b) Carbonyl (C=0) and Alcohol (c) A Vinyl carbon. Participation of Neighbouring groups in Nucleophilic substitution by (a) Carboxylate anion (b) -NH2 Group (c) Hydroxyl groups (d) Acetoxyl group (e) Phenyl group (f) -SH group	25%
2.	**(A) Aromaticity** Aromaticity, aromatic character, Frost circle diagram for cyclobutadiene, benzene and others. Resonance and chemical stabilization-aromatic character based on NMR criteria, Huckels rule, energy level of π molecular orbitals, Huckels moleculer orbital (HMO) method, MO of simple organic systems such as ethene, allyl and butadiene Aromaticity in benzenoid and non-benzenoid compounds and charged rings, annulenes, fulvenes, azulenes, antiaromaticity and homo-aromaticity. **(B) Acid base** concept, pKa, Hammette-equation, Concept of hindered base, The effect of structure on the strength of acids and bases.	25%

3.	**A. (A) Reactive intermediates** (1) Carbocations stability, structure, generation and fate (2) Carbanions- stability, structure, generation and fate of carbanions (3) Carbenes-stability and structure, the generation and fate of carbenes. (4) Free radicals: stability, structure, generation and fate of free radicals, NBS (5) Nitrene: stability, structure, generation, reaction **B. Rearrangements:** General mechanistic considerations, nature of migration, migratory aptitude, and memory effects in respect of following. (1) Carbon to Carbon migration of R, H and Ar (i) Pinacol- Pinacolone rearrangement (ii) Favorskii rearrangement (iii) (iii) Wagner-Meerwein rearrangement (2) Carbon to Nitrogen migrations: (i) Curtius rearrangement (ii) Schmidt rearrangement (iii) Lossen rearrangement	25%
4.	**Stereo Chemistry** Optical and geometrical isomerism, origin of chirality and chiral centre, axis and plane, helicity, Enantiotopic and diastereotopic atoms, groups and faces, prochiral centre, prochiral environments, chiral drugs. Stereo chemistry in additions to alkenes (Syn, Anti, Diels,-alder)	25%

Teaching Methodology	To meet the effective teaching and the learning requirements, teachinglearning methodology comprise classroom teaching, use of e-resources, library books, IT tools, encouraging students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation of pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand generation of reactive intermediates, their mechanism, rearrangement based on each intermediate, application of reactive intermediate in organic synthesis and industries application.
2.	
3.	Learn difference between eliminations and addition reaction, concept of anchimeric assistance in various groups like sulphide, halogen, phenyl, hydroxyl, tosylates & mesilates, amino group etc, aromatic nucleophilic substitution through addition elimination, elimination addition, cine substitution and their synthetic application.
4.	Detect chirality in moleculer structure, recognize the relationship between enantiomeric and diastereomeric structures, understand and distinguis stereoselective and stereospecific reactions, dynamic resolution, confirmative study of various substituted aromatic and fused aromatic rings and their application in pharmaceutical industry.

Suggested References:

1. Advanced Organic Chemistry, Reactions Mechanisms and Structure , J. March, 6 th Edition, John Wiley.
2. Carbenes, nitrenes and arynes, T.L. Gilchrist and C.W. Rees.
3. Guidebook to Mechanism in Organic Chemistry by Peter Sykes, 6th Edition, Prentice Hall.
4. Advanced Organic Chemistry Part A: Structure and Mechanism and Part B:Reaction and synthesis ,Francis A. Carey, Richard J. Sundberg, 5th Edition, Springer .
5. Organic Chemistry, Johnathan Clayden, Nick Geeves, Stuart Warren, 1st Edition, Oxford University Press.
6. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, 3rd Edition, Blackie Academic and Proffessional.
7. Stereo Chemistry , P.S. Kalsi , New Age Publications.
8. Reagents in Organic Synthesis- Fieser and Fieser, John Wiley.
9. Physical Organic Chemistry by Jack Hynes,(plenum publication)
10. Organic Chemistry, T.W. Graham Solomons and Graig B. Frymes, John Wiley and Sons.
11. Organic Chemistry, F. A. Carey, McGraw Hill Edition.
12. General Organic Chemistry Sachin Kumar Ghose, New Central book agency.
13. Organic Chemistry Vol 1-2 I.L.Finar 5th edition,ELBS.

On-line resources to be used if available as reference material.

Master of Science, Organic Chemistry Practical, Semester-I

Course Code	Title of the Course	Title Credits of Course	Hours Per Week
MSC1P101	ORGANIC CHEMISTRY PRACTICALS	4	4hrs

Course Objectives	• To impart basic knowledge for carrying out preparation. • Understand nature of reaction and establishment of reaction condition with mechanism. • To understand calculation of mole and mole ratio for eachreaction. • Isolation of product from individual step and purification by crystallization. • Determination of physical constant and confirmation of product.

Course Content	
1.	**Preparation of organic compounds**: **i.** Nitration **ii.** Bromination **iii.** Acylation **iv.** Reduction **v.** Oxidation **vi.** Condensation reaction **vii.** Diatization reaction **viii.** Friedl-Craft's reaction **ix.** Cannizzaro reaction **x.** Aldol condensation

Teaching-Learning Methodology	Introduction, demonstration of handling equipment, reference books and frequent instruction according to the respective practical.

Evaluation of pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the basics to carry out reactions, nature of reaction and calculation of mole and mole ratio.
2.	Establish mechanism and monitor reaction at specified condition.
3.	Work-up after the completion of reaction and purification.
4.	Confirmation of product through the references.
5.	Appreciate good laboratory practices.

Suggested References:

1. A textbook of practical organic chemistry – A. I. Vogel
2. Practical organic Chemistry – Mann and Saunders
3. handbook of quantitative and qualitative analysis – H. T. Clarke
4. Comprehensive Practical Organic Chemistry: Qualitative Analysis V K Ahluwalia & S. Dhingra.
5. Comprehensive Practical Organic Chemistry: Preparations and Quantitative Analysis V K Ahluwalia & R. Aggarwal Universities Press.
6. An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal.

M.Sc. Physical Chemistry, Semester – I

Course Code	**Title of the Course**	**Title Credits of Course**	**Hours Per Week**
MSC1C103	PHYSICAL CHEMISTRY	4	4hrs

Course Objectives	• To understand concept of thermodynamics in solution. • To understand concept of thermodynamics in solution. • To understand the basics of surface chemistry. • To understand the molecule's crystals and bonding iin solid structure.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**Chemical thermodynamics:** Nernst heat theorem and its applications to gaseous system, third law of thermodynamics and its applications to evaluate absolute entropies of solids, liquids and gases; partial molar quantities and their determination, Gibbs-Duhem equation, chemical potential, chemical potential of idea gases and solutions, Raoult's law, real solutions, free energy and solutions, activity and activity coefficients, methods of determination of activity and activity coefficients, fugacity of gases and liquids and methods of its determination	25%
2.	**Chemical Kinetics:** Unimolecular reactions, chain reactions and branched chain reactions, explosion limits, chain reaction between hydrogen and bromine, theory of absolute reaction rates, kinetic isotope effect. Enzyme catalysed reactions, mechanism, kinetics and some examples.	25%
3.	**Solid state chemistry:** Bonding in solids and electronic structure in solids, bond theory-metals, semiconductors and insulators, defects in crystals, calculation of schottly and Frenkel defects using statistical method, non-stoichiometry, solid electrolytes, diffusion in solids, electrical conductivity in solids, super conductivity.	25%
4.	**Surface chemistry:** Physical and chemical adsorption, BET and HJ equations, heat of adsorption, determination of surface area of adsorbents, surface tension, Gibb's equation, surface active agents, micellization, critical micellar concentration (cmc), detergency.	25%

Teaching Methodology	To meet the effective teaching and the learning requirements, teaching learning methodology comprise classroom teaching, use of e-resources, library books , IT tools, encouraging students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation of pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Students learn thermodynamic terminology, fundamental thermodynamic properties, properties of solution, fundamental knowledge assist student to understand related topic in next semester.
2.	Understand kinetics of different types of reaction. Understand the factors responsible for behaviour of different kind of chemical reaction
3.	Understand Bonding in solids and electronic structure in solids, bond theory-metals, semiconductors and insulators.
4.	Understand physical phenomena of surface chemistry. Application of surface-active substance and factor affecting surface chemistry, adsorption of surface active materials

Suggested References:

1. Advanced Organic Chemistry, Reactions Mechanisms and Structure , J. March, 6 th Edition, John Wiley.
2. Carbenes, nitrenes and arynes, T.L. Gilchrist and C.W. Rees.
3. Guidebook to Mechanism in Organic Chemistry by Peter Sykes, 6th Edition, Prentice Hall.
4. Advanced Organic Chemistry Part A: Structure and Mechanism and Part B:Reaction and synthesis ,Francis A. Carey, Richard J. Sundberg, 5th Edition, Springer .
5. Organic Chemistry, Johnathan Clayden, Nick Geeves, Stuart Warren, 1st Edition, Oxford University Press.
6. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, 3rd Edition, Blackie Academic and Proffessional.
7. Stereo Chemistry, P.S. Kalsi , New Age Publications.
8. Reagents in Organic Synthesis- Fieser and Fieser, John Wiley.
9. Physical Organic Chemistry by Jack Hynes,(plenum publication)
10. Organic Chemistry, T.W. Graham Solomons and Graig B. Frymes, John Wiley and Sons.
11. Organic Chemistry, F. A. Carey, McGraw Hill Edition.
12. General Organic Chemistry Sachin Kumar Ghose, New Central book agency.
13. Organic Chemistry Vol 1-2 I.L.Finar 5th edition,ELBS.

On-line resources to be used if available as reference material.

Master of Science, Physical Chemistry Practical, Semester-II

Course Code	Title of the Course	Title Credits of Course	Hours Per Week
MSC1P102	PHYSICAL CHEMISTRY PRACTICALS	4	4hrs

Course Objectives	• To study the physical chemistry parameters for reaction between acid and base. • To study the behaviour of surfactant in aqueous solution. • To determine the concentration of solution by conductometer, potentiometer, pH meter. • To understand the conductivity behaviour of electrolytes solution. • Partitioning behaviour of component in two phases

Course Content	
1.	**Conductometry** **1.** Titration of mixture of strong acid and weak acid with strong base (HCl + HAC against NaOH) Titration of mixture of strong acid and weak acid with weak base (HCl + HAC against **2.** H4OH) Solubility product of sparingly soluble salts – PbSO4 & BaSO4
2.	**Potentiometry** **1.** Titration of mixture of strong acid and weak acid with strong base (HCl + HAC against

	NaOH) Titration of mixture of strong acid and weak acid with weak base (HCl + HAC against NH4OH) **2.** Solubility product of sparingly soluble salts – PbSO4 & BaSO4
3.	**pH metry** **1.** Titration of mixture of strong (HCl) and weak (HAC) acid with NaOH / NH4OH and find the strength of the acids. **2.** Titration of mixture of bases (Na2CO3 & NaHCO3) with standard HCl and find the concentration of bases.
4.	**Adsorption and kinetics** 1. Hydrolysis of esters 2. Reaction between K2S2O8 and KI. (a=b & a≠b)
5.	**Distribution method.** **1.** Distribution of acetic acid between H2O and butanol. **2.** Distribution of HAC between H2O and CHCl3 / CCl4. **3.** Distribution of I2 between H2O and CCl4.

Teaching-Learning Methodology	Introduction, demonstration of handling equipment, reference books and frequent instruction according to the respective practical.

Evaluation of pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	calculate the concentration of unknown solution by pH, potentiometer, and conductometer
2.	Understand preparation of solutions.

Suggested References:

1. Advanced Practical Physical Chemistry by Yadav J. B., Krishna Prakashan Media .
2. Practical Physical Chemistry, Dr. M. Satish Kumar Sankalp Publication.
3. Gurtu, J. N., Kapoor, R., Advanced Experimental Chemistry S. Chand & Co. Ltd.

M.Sc. Analytical chemistry, Semester – I

Course Code	**Title of the Course**	**Title Credits of Course**	**Hours Per Week**
MSC1C104	ANALYTICAL CHEMISTRY	4	4hrs

Course Objectives	• To understand concept of electromagnetic radiation, auxochrome, chromophores, various factors affect the UV-Visible spectra and impart the knowledge to understand the spectra. • To make them aware about data handling, good laboratory practice, sampling, and calibration methods.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**Analytical Objectives, Data Handling and Good Laboratory Practice** (GLP) Scope of analytical science and its literature, qualitative and quantitative analysis, Classification of analytical methods, basis of classical and Instrumental method of analysis. GLP- standard operating procedures, quality assurance and quality control. Non-aqueous titrations: principles, theory, role of solvents and their classification, properties of solvents, Standard titration curves, factors affecting non-aqueous titrations, advantages, and limitations	25%
2.	**Sampling and Calibration Methods** Sampling and sample preparation, general steps in chemical analysis, calibration of glass wares. Finding the best straight line-least square regression, correlation coefficient; Calibration curves, standard addition technique and internal standards. Chemical concentrations.	25%
3.	**Fundamentals of Spectrophotometry** Properties of light, absorption of light, interaction of light with matter and origin of spectra. The spectrophotometer- calibration, sources of light, monochromators, and detectors. Beer's law in chemical analysis, photometric accuracy- Ringbom Plot, derivative spectrophotometry, optical rotatory dispersion and circular dichroism.	25%
4.	**Applications of Spectrophotometry** Analysis of mixture-resolved and unresolved spectra, measurement of equilibrium constant: Scatchard Plot; Stoichiometry-method of continuous variation- the Jobs plot. Photometric titrations. Application for quantitively measurement of spectrophotometry.	25%

Teaching Methodology	To meet the effective teaching and the learning requirements, teaching learning methodology comprise classroom teaching, use of e-resources, library books , IT tools, encouraging students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation of pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the good laboratory practices and application.
2.	Understand data sampling.
3.	Understand the basic concept of electromagnetic radiation and their interaction with the matter and use of UV-Visible spectrophotometer in structure identification and quantitative determination.

4.	Understand application of spectrophotometry.

Suggested References:

1. "Quantitative Chemical Analysis" by Daniel C. Harris, 5th Edition, W.H. Freeman and Company, New York.
2. "Analytical Chemistry" by Gary D. Christian, 6th Edition, John Wiley and Sons Inc. New Jersey.
3. "Principles of Instrumental Analysis" by Douglas A. Skoog, 3rd Edition, HoltSaunders International Edition.
4. "Instrumental Methods of Chemical Analysis" by Galen W. Ewing, 4th Edition, International Student Edition.

On-line resources to be used if available as reference material.

Master of Science, Analytical Chemistry Practical, Semester-I

Course Code	Title of the Course	Title Credits of Course	Hours Per Week
MSC1P102	ANALYTICAL CHEMISTRY PRACTICALS	4	4hrs

Course Content	
1.	Calibration of glass wares and balance.
2.	Calibration of Ph meter, conductometer, and potentiometer.
3.	Preparation stock solution and standardization [HCl ,NaOH, KHP]
4.	Determination of available chlorine in bleaching powder.
5.	Determination of vitamin C in orange juice/amla.
6.	Determination of acetic acid in vinegar.
7.	Determination of sodium carbonate and sodium bicarbonate in washing soda.
8.	Determination of ascorbic acid in vitamin C tablets.
9.	Determination of calcium and magnesium in water sample.
10.	Determination of total dissolved solids in water samples.
11.	Determination of sulphate in water sample.
12.	Determination of chloride in water sample.

Teaching-Learning Methodology	Introduction, demonstration of handling equipment, reference books and frequent instruction according to the respective practical.

Evaluation of pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%

2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	**Try to understand how calibrate all type of glassware before any practical.**
2.	**To under determination method of some ions and some compounds in various samples.**

Suggested References:

1. Analytical Chemistry Practice, John H. Kennedy, Saunders College Publishing, Second Edition 1990.
2. Vogels Textbook of Quantitative Chemical Analysis, 6th Edition, 2002.

Structure of M.Sc. Syllabus

Semester-II

Sr. No.	**Course Code**	**Course Title**	**L**	**T/C/D**	**Credit**
1	MSC1C201	Inorganic Chemistry	4		4
2	MSC1C202	Organic Chemistry	4		4
3	MSC1C203	Physical Chemistry	4		4
4	MSC1C204	Analytical Chemistry	4		4
5			12	3	6+3
Total			**28**	**3**	**25**

Faculty code: Science **Subject code:**

Level Code:

Name of program: M.Sc. **Subject: Chemistry**

External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No.	Course group	Credit	Internal marks	External marks	Total marks
M.SC.	**II**	I	Core	04	30	70	100
		II	Core	04	30	70	100
		III	Core	04	30	70	100
		IV	Core	04	30	70	100
		-	Practical+ T/C/S	06+3	60	140	200
		Total		**25**	**180**	**420**	**600**

M.Sc. Inorganic Chemistry, Semester – II

Course Code	Title of the Course	Title Credits of Course	Hours Per Week
MSC1201	INORGANIC CHEMISTRY	4	4hrs

Course Objectives	• To understand concept of symmetry and group theory with its application. • To understand basics of Quantum mechanics, familiarize with various types of operators and implant the knowledge of orbital configuration. • To learn the inorganic reaction mechanism. Different types of reaction mechanism and also various types of transition state theory • Understanding of concepts of metal cluster, classification of metal clusters, Wade's rule, Carboranes, low and high nuclearity carbonyl clusters.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**Chemical Bonding** The method of linear combination VSEPR, Walsh diagrams(tri-and penta-atomic molecules), dπ –pπ bonds, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules. Simple Huckel theory of linear conjugated systems, simple Huckel theory of the cyclic conjugated system and aromaticity, self-consistent filed method, valence state ionization potentials, Pariser-Parr-Pople appoximation. Band theory of solids, Fermi level, electrical properties, insulators, semiconductors, and superconductors (properties).	25%
2.	**Application of symmetry** Application of symmetry to hybrid orbital, molecular orbitals, hybridization schemes for σ orbitals, π bonding and molecular orbital for ABn type of molecules. Application of symmetry to molecular vibrations, interpretation of IR and Raman spectral data.	25%
3.	**Organometallic Compounds** Organometallic compounds of transition elements, stability of metal carbon bond in complexes. Synthesis uses and structure of organometallic compounds of π bonding organic ligands, 2-electron ligands, olifinic and acetylinic complexes, compound with 3 electron ligand – allylic complexes, compounds. With 4- electron ligands butadiene complexes, n4 complexes of cyclopentadiene, compounds with 5 electron ligands – cyclopantadionyl, compounds with 6 electron ligands, n6 complexes of benzene and its derivatives. Role of organometallic compounds in catalytic reaction.	25%
4.	**Reaction Mechanism** Mechanism of substitution reaction in square planar complexes. Kinetics of substitution reaction of platinum (II) complexes Effect of leaving group, effect of charge, steric effect, solvent effect, effect of nucleophile, effect of temperature and other effects. Oxidation-Reduction reaction, electron transfer, tunnelling effect, Marcus –Hush theory, one and two electrons transfer inner sphere and outer sphere, effect of ions on rate, electron transfer through extended bridges, unstable oxidation states, hydrated electron.	25%

Teaching Methodology	To meet the effective teaching and the learning requirements, teaching learning methodology comprise classroom teaching, use of e-resources, library books , IT tools, encouraging students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation of pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn regarding quantum mechanics, angular momentum, understanding the solution of

	Schrodinger equation, Different types of operators and their uses
2.	Understand the of matrices and vectors matrix notations, reducible representation and their relation, applications of group theory
3.	Understand the definitions of magnetic properties, type of magnetic bodies, determination of magnetic susceptibility and its applications.
4.	Learn regarding some reaction and mechanism.

Suggested References:

1. Introduction to Quantum Chemistry, A. K. Chandra, Tata MacGraw Hill.
2. Quantum Chemistry, Ira N. Levine, Prentice Hall.
3. Quantum Chemistry by R. K. Prasad, New Age International Publishers (1985)
4. D. A. McQuarrie Quantum Chemistry, OUP 1983.
5. M. W. Hanna, Quantum Mechanics in Chemistry, The Benjamin Pub.
6. Lectures on Chemical Bonding and Quantum Chemistry, S. N. Datta, A Prism Book.
7. Group theory and symmetry in chemistry, L. H. Hall(McGraw Hill)
8. Coulson's Valence, R. McWeeny, ELBS
9. F. A. Cotton, Chemical Applications of Group theory, Wiley Eastern 2nd Edn.1992
10. V. Ramkrishnan & M. S. Gopinadhan, Group theory in Chemistry Vishal Pub.1996.
11. Inorganic Chemistry, Third Edition, Alan G. Sharpe.
12. Theoretical Inorganic Chemistry, M. C. Day, J. Shellin .
13. Chemistry, Fifth Edition, John E. McMurry, Robert C. Fay.
14. An Introduction to Theoretical Chemistry, Jack Simons, Cambridge.
15. Progress in inorganic Chemistry, Vols 18 and 38 ed. J. J. Lippard, Wiley.
16. Mechanism of Inorganic Reactions, F. Basolo and R. G. Persons, Wiley Pub.
17. Reaction Mechanism of Coordination Compounds, C. H. Langford and H. B. Gray,
18. Inorganic Reaction Mechanisms, M. L. Tobe, Nelson Pub.
19. Inorganic Chemistry, K. F. Purcell and J. C. Kotz.
20. Principles of Bioinorganic Chemistry, S. J. Lippard and J. M. Bers.
21. Mehrotra R. C. and Singh A. Organo Metallic Chemistry, Willey Eastern Ltd., New Delhi.
22. Coates G. E. Green MIH Wade, K and Aylett B. J. Organo Metallic Comounds Chapman and Hall, London

On-line resources to be used if available as reference material.

Master of Science, Inorganic Chemistry Practical, Semester-II

Course Code	Title of the Course	Title Credits of Course	Hours Per Week
MSC1P201	INORGANIC CHEMISTRY PRACTICALS	4	4hrs

Course Objectives	• To impart basic knowledge of qualitative analysis of Inorganic mixture • To identify three anions and three cations including one rare earth element by group separation. • To impart knowledge of different radicals by confirmative test.

	• Preparation of inorganic metal salts and it's crystallization • To confirm the structure and prepare the relevant derivative.

Course Content	
1.	Preparation and determination of purity of double and complex salts. At least ten preparations should be done.
2.	Colorimetric estimation of any five out of Ni, Fe.

Teaching-Learning Methodology	Introduction, demonstration of handling equipment, reference books and frequent instruction according to the respective practical.

Evaluation of pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand basics analysis of Inorganic preparation.
2.	Understand Colorimetric analysis n practical methods.

Suggested References:

1. Vogels Textbook of Quantitative Chemical Analysis, 6th Edition, 2002.
2. Advanced Practical Inorganic Chemistry, Gurdeepraj,Goel Publishing House, 2001.
3. An Advanced Course in Practical Chemistry,A.K. Nad, B. Mahapatra, A. Ghosal, New Central Book Agency, 2004.

M.Sc. Organic Chemistry, Semester – II

Course Code	Title of the Course	Title Credits of Course	Hours Per Week
MSC1C201	ORGANIC CHEMISTRY	4	4hrs

Course Objectives	• To understand concept of reactive intermediate and their application in organic synthesis. • To learn aromaticity based on different concept, measurement of aromaticity through various parameters, annulenes, azzulene and types of aromaticity. • To learn anchimeric assistance, stereo chemistry and internal substitution reaction of aliphatic and allylic compounds. Aromatic nucleophilic

	substitution, cine substitution, elimination reactions, their stereo chemistry and mechanisms. • Understanding of concepts of chirality, topicity, prochirality, dynamic resolutions, types of stereo selective and stereo specific reactions, conformation of substituted and fused aromatic rings along with respective strains theories.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**Spectroscopy** A. 13 CNMR: General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. B. Mass spectroscopy: Introduction, ion production, EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement. Nitrogen rule. High resolution mass spectroscopy. C. Examples of mass spectral fragmentation of organic compounds, NMR, IR, UV with respect to their structure determination.	25%
2.	**(A) Photochemistry:** Photochemical reactions: Principles of energy transfer, electronic excitation and molecular orbital view of excitation, excited states and fate of excited molecules (modified Jablonski diagram), Photosensitization. (2) Photochemistry of carbonyl compounds: Representation of excited states of ketones, photoreduction Norrish typeI& Π reactions, Reactions of cyclic Ketone, oxetane formation (Paterno-Buchi reaction) (3) Di-π methane rearrangement, Dienone photochemistry, cis-trans isomerisation and photochemistry of conjugated olefins. **(B) Chemistry of Heterocycles:** 1. Nomenclature of heterocycles : Replacement and systematic nomenclature (Hantzsch Widman system) for monocyclic, fused and bridged heterocycles. General chemical behavior of aromatic heterocycles. 2. Five-membered heterocycles : Oxazole, Isoxazole, Thiazole, Pyrazole, Imidazole, Triazoles, Tetrazole. 3. Six membered and benzofused six membered heterocycles : Pyrazine, Pyridazine, Pyrimidine, Cinnoline, Quinazoline, Quinoxaline.	25%
3.	**Name reactions:** General nature, method, mechanism and synthetic applications of the following reactions: a) Vilsmeier-Haack reaction b) Mitsunobu reaction c) Suzuki reaction d) Balz-Schiemann reaction e) Sonogarshira coupling. f) Stobbe condensation g) Jones oxidation h) Swern oxidation reaction i) Perkin reaction j) Darzen's glycidic ester synthesis	25%

	k) Mannich reaction l) Finkelstein reaction m) Ullmann reduction n) Witting reaction o) Knoevanagel reaction	
4.	**Reagents in organic synthesis:** Mechanism selectivity and utility of following reagents: a. Gilman's reagent-Lithium di-methylcuprate b. Lithium di-isopropylamide (LDA) c. Di cyclohexyl carbodiimide (DCC) d. 1,3 – Dithiane (Umpolung reagent) e. Dess- Martin periodinane f. Baker's yeast (vii) g. Azo-bis-iso-butyronitrile (viii) h. Oxaziridine (ix) Thionyl Chloride (x) i. DDQ (xi) j. Ter-butyl Hydro Peroxide (xii) k. Dimethyl dioxirane (xiii) l. Phase transfer catalysis Quaternary	25%

Teaching Methodology	To meet the effective teaching and the learning requirements, teaching learning methodology comprise classroom teaching, use of e-resources, library books, IT tools, encouraging students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation of pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand generation of reactive intermediates, their mechanism, rearrangement based on each intermediate, application of reactive intermediate in organic synthesis and industries application.
2.	Learn difference between eliminations and addition reaction, concept of anchimeric assistance in various groups like sulphide, halogen, phenyl, hydroxyl, tosylates & mesilates, amino group etc, aromatic nucleophilic substitution through addition elimination, elimination addition, cine substitution and their synthetic application.
3.	Detect chirality in moleculer structure, recognize the relationship between enantiomeric and diastereomeric structures, understand and distinguis stereoselective and stereospecific reactions, dynamic resolution, confirmative study of various substituted aromatic and fused aromatic rings and their application in pharmaceutical industry.

Suggested References:

1. Advanced Organic Chemistry, Reactions Mechanisms and Structure , J. March, 6 th Edition, John Wiley.
2. Carbenes, nitrenes and arynes, T.L. Gilchrist and C.W. Rees.
3. Guidebook to Mechanism in Organic Chemistry by Peter Sykes, 6th Edition, Prentice Hall.
4. Advanced Organic Chemistry Part A: Structure and Mechanism and Part B:Reaction and synthesis ,Francis A. Carey, Richard J. Sundberg, 5th Edition, Springer .
5. Organic Chemistry, Johnathan Clayden, Nick Geeves, Stuart Warren, 1st Edition, Oxford University Press.
6. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, 3rd Edition, Blackie Academic and Proffessional.
7. Stereo Chemistry, P.S. Kalsi , New Age Publications.
8. Reagents in Organic Synthesis- Fieser and Fieser, John Wiley.
9. Physical Organic Chemistry by Jack Hynes,(plenum publication)
10. Organic Chemistry, T.W. Graham Solomons and Graig B. Frymes, John Wiley and Sons.
11. Organic Chemistry, F. A. Carey, McGraw Hill Edition.
12. General Organic Chemistry Sachin Kumar Ghose, New Central book agency.
13. Organic Chemistry Vol 1-2 I.L.Finar 5th edition,ELBS.

On-line resources to be used if available as reference material.

Master of Science, Organic Chemistry Practical, Semester-II

Course Code	Title of the Course	Title Credits of Course	Hours Per Week
MSC1P101	ORGANIC CHEMISTRY PRACTICALS	4	4hrs

Course Objectives	• To impart basic knowledge for carrying out preparation. • Understand nature of reaction and establishment of reaction condition with mechanism.

	• To understand calculation of mole and mole ratio for eachreaction. • Isolation of product from individual step and purification by crystallization. • Determination of physical constant and confirmation of product.

Course Content	
1.	Mixture analysis: ternary mixture to be given. (S+S+S) or (L+L+L). Type determination. Separation by physical and chemical methods. (Both permitted in case of liquids)

Teaching-Learning Methodology	Introduction, demonstration of handling equipment, reference books and frequent instruction according to the respective practical.

Evaluation of pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	**To aware types of organic mixture and separation on the basis of their type.**

Suggested References:

1. A textbook of practical organic chemistry – A. I. Vogel.
2. Practical organic Chemistry – Mann and Saunders.
3. A handbook of quantitative and qualitative analysis – H. T. Clarke.
4. Comprehensive Practical Organic Chemistry: Qualitative Analysis V K Ahluwalia & S. Dhingra.
5. Comprehensive Practical Organic Chemistry: Preparations and Quantitative Analysis V K Ahluwalia & R. Aggarwal Universities Press.
6. An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal.

M.Sc. Physical Chemistry, Semester – II

Course Code	Title of the Course	Title Credits of Course	Hours Per Week
MSC1C103	PHYSICAL CHEMISTRY	4	4hrs

Course Objectives	
	• To understand concept of thermodynamics in solution. • To understand type of interactions and orientation of molecules in solution. • To understand basic concept of statistical thermodynamics. • Understanding of concepts of kinetics of different types of chemical reaction.

	• To lean basic concept of synthesis of polymer and solution behaviour of polymer

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**Statistical thermodynamics**: Concepts of distribution of molecules, thermodynamic probability, permutations and combinations, Boltzmann's most probable distribution, partition function-translational, vibrational, rotational, electronic nuclear partition functions.	25%
2.	**Nuclear chemistry**: Nuclear properties-nuclear radius, coulombic and nuclear potential radius, nuclear spin and angular momentum, magnetic moment, nuclear binding energy, nuclear models-shell model, liquid drop model, Fermi gas model, collective model, radioactive decay, nuclear reactions, evaporation, spallation, fragmentation, fission and fusion reactions, accelerators, reaction cross section, use of radioisotopes as tracers.	25%
3.	**Polymer chemistry**: Kinetics and mechanism of polymer processes, criteria of polymer solubility, thermodynamics of polymer solutions, polymer characterization, molecular weight of polymer (number average and weight average) , methods of molecular weight determination, properties of polymers and applications.	25%
4.	**Electrochemistry**: Sign convention-American, European and IUPAC; Determination of dissociation constant of monobasic acids by conductometry, determination of dissociation constants of monobasic and polybasic acids by potentiometry. The rate of charge transfer, polarization and overvoltage, basic principle of polarography, origin of different types of current; equation of polarographic wave, Ilkovic equation.	25%

Teaching Methodology	To meet the effective teaching and the learning requirements, teaching learning methodology comprise classroom teaching, use of e-resources, library books , IT tools, encouraging students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation of pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Students learn thermodynamic terminology, fundamental thermodynamic properties, properties of solution, fundamental knowledge assist student to understand related topic in next semester.

2.	Understand kinetics of different types of reaction. Understand the factors responsible for behaviour of different kind of chemical reaction
3.	Learn relation between quantum chemistry and statistical thermodynamics. Understand basic terminology and their application in calculation of thermodynamic function.
4.	Understand the method for synthesis of polymer and their characterization

Suggested References:

1. Textbook of physical chemistry – W.J.Moore
2. Textbook of physical chemistry – Glasstone
3. Textbook of physical chemistry – P.Atkins
4. Advanced physical chemistry – Surdeep Raj
5. Advanced physical chemistry – J.N.Gurtu, A.Gurtu
6. Thermodynamics for chemists –Glasstone
7. Physical chemistry – S. Castellian
8. Thermodynamics of non equilibrium processes- Karapitianeh
9. Chemical Kinetics- Laidler
10. Chemical Kinetics – Frost and Pearson
11. Solid state chemistry – H.Keer
12. Solid state chemistry- Hannay
13. Chemistry of solids – Azaroff
14. Surface chemistry – Adamson
15. Surface chemistry – Osipov

Master of Science, Physical Chemistry Practical, Semester-II

Course Code	Title of the Course	Title Credits of Course	Hours Per Week
MSC1P102	PHYSICAL CHEMISTRY PRACTICALS	4	4hrs

Course Objectives	• To study the physical chemistry parameters for reaction between acid and base. • To study the behaviour of surfactant in aqueous solution • To determine the concentration of solution by colorimetry • To understand the conductivity behaviour of electrolytes solution. • Partitioning behaviour of component in two phases

Course Content	
1.	**Conductometry** **1.** Test of validity of Ostwald's dilution law and determination of dissociation constant of weak electrolyte like CH3COOH & ClCH2COOH. **2.** Verification of Debye-Huckel-Onsager's equation in case of strong electrolytes like HCl, NaCl.
2.	**Potentiometry** **1.** Titration of dibasic acid like malonic, oxalic, succinic acid with NaOH and find the dissociation constant of acid. **2.** Precipitation titration → Titration of halids with AgNO3. (Kcl AgNO3 Kcl+KI AgNO3. **3.** Redox titration Ferrous ammonium sulfate –KMnO4 , K2Cr2O7.
3.	pH metry 1. Determination of dissociation constant of weak acid like acetic and monochloroacetic acid
4.	Adsorption and kinetics 1. Adsorption of acetic acid on activated charcoal 2. Determination of order of reaction and energy of activation between K2S2O8 and KI.
5.	Distribution method 1. Determination of the formula of the complex formed between cupric ion and ammonia by distribution method.

Teaching-Learning Methodology	Introduction, demonstration of handling equipment, reference books and frequent instruction according to the respective practical.

Evaluation of pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	calculate the concentration of unknown solution by pH, potentiometer, and colorimeter

Suggested References:

1. Practical physical chemistry –J.B.Yadav
2. Practicals in physical chemistry – P.S.Sindhu
3. Experimental physical chemistry – R.C.Das, B.Behera
4. Experiments in physical chemistry- P.H.Parsania, F. Karia

M.Sc. Analytical chemistry, Semester – II

Course Code	Title of the Course	Title Credits of Course	Hours Per Week
MSC1C104	ANALYTICAL CHEMISTRY	4	4hrs

Course Objectives	• To understand concept of electromagnetic radiation, auxochrome, chromophores, various factors affect the UV-Visible spectra and impart the knowledge to understand the spectra. • To understand basics of concepts of chromatography, their classification and importance as well as working of various parts of the chromatography instruments. Use of this TLC and GC in various application. • To learn the different types of errors occur in qualitative and quantitative and the validation of result obtained in experiments with the help of Q test and Students't test. • To learn the thermal methods, their instrumentation, various factors effect on the experimental results and their application in various field.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**Sample Preparation Techniques** Liquid-liquid extraction/solvent extraction-partition coefficient, distribution ratio and percent extraction. Solvent extraction of metal ions-ion association complexes and metal chelates, multiple batch extraction, Craig's counter-current distribution. Accelerated and Microwave assisted extraction, protein precipitation and solid phase extraction (SPE). Hibride SPE and solid phase micro extraction (SPME)	25%
2.	**Chromatographic Methods** Principles of chromatography, classification of chromatographic techniques based on mechanism of retention, configuration, mobile and stationary phase. Efficiency of separation- plate theory (theoretical plate concept) and rate theory (Van Deemter equation). Principles and applications of Paper chromatography, thin layer chromatography, HPTLC and Ion exchange chromatography. Countercurrent chromatography for isolation of nat	25%
3.	**pH metry and Conductometry** pH measurement with glass electrode, working of glass electrode, mechanism of pH measurement, calibration of glass electrode, errors in pH measurement. Electrical conductance in solutions of electrolytes, measurement of conductance, conductometric titrations- acid-base, precipitation, and complex formation titrations.	25%

4.	**Potentiometry and Ion-selective electrodes** Electrochemical cell, cell potentials, sign convention for electrode potentials, types of reference and indicator electrodes-metallic indicator and membrane indicator electrodes. Classification of membrane electrodes-ion-selective and molecular-selective electrodes. Principle, properties and design of ionselective electrodes. Crystalline and non-crystalline membrane electrodes. Gas-sensing probes and enzyme substrate electrodes. Applications of potentiometric titrations.	25%

Teaching Methodology	To meet the effective teaching and the learning requirements, teaching learning methodology comprise classroom teaching, use of e-resources, library books , IT tools, encouraging students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation of pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the basic concept of electromagnetic radiation and their interaction with the matter and use of UV-Visible spectrophotometer in structure identification and quantitative determination.
2.	Recognize the use of different stationary and mobile phase for the separation of organic molecule and identify the problems and their solution during the analysis and learn the use of the chromatography for those whose don't identify by the techniques.
3.	Understand the basic concept of electromagnetic radiation and their interaction with the matter and use of UV-Visible spectrophotometer in structure identification and quantitative determination.
4.	Use of the thermometric techniques when the other methods are failed. The requirement ofthe techniques and identified the problems arise during the analysis.

Suggested References:

"Quantitative Chemical Analysis" by Daniel C. Harris, 5th Edition, W.H. Freeman and Company, New York. 2 "Analytical Chemistry" by Gary D. Christian, 6th Edition, John Wiley and Sons Inc. New Jersey. 3 "Principles of Instrumental Analysis" by Douglas A. Skoog, 3rd Edition, Holt- Saunders International Editions.

Master of Science, Analytical Chemistry Practical, Semester-I

Course Code	Title of the Course	Title Credits of Course	Hours Per Week
MSC1P102	ANALYTICAL CHEMISTRY PRACTICALS	4	4hrs

Course Objectives	• Learn complexometric titration of different ions in various semples. • Lear how to find the saponification value, iodine values, acid value, of different oils.

Course Content	
1.	Determination of saponification value of oil.
2.	Determination of iodine value of oil.
3.	Determination of acid value of oil
4.	Determination of dissolved oxygen.
5.	Determination of chemical oxygen demand.
6.	Determination of iron in iron tablets.
7.	Simultaneous estimation of chromium (III) and iron (III) by EDTA titration.
8.	Simultaneous estimation of calcium (II) and zinc (II) by EDTA titration.
9.	Simultaneous estimation of lead (II) and magnesium (II) by EDTA titration.
10.	Determination of Ca in Ginger Sample.

Teaching-Learning Methodology	Introduction, demonstration of handling equipment, reference books and frequent instruction according to the respective practical.

Evaluation of pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Learn complexometric titration of different ions in various semples.
2.	Lear how to find the saponification value, iodine values, acid value, of different oils.

Suggested References:

1. Analytical Chemistry Practice, John H. Kennedy, Saunders College Publishing, Second Edition 1990.
2. Vogels Textbook of Quantitative Chemical Analysis, 6th Edition, 2002

M.Sc. Semester – III

(Organic Chemistry)

Sr. No.	Course Title	L	T/C/S	Credit
1.	Natural Products and Biomolecules	4	1	4
2.	Medicinal Chemistry	4	1	4
3.	Organic Chemistry	4	1	4
4.	Industrial Chemistry	4	1	4
5.	Practical	12		8
		28	4	24

External Examination Time: 03hrs

Name of Exam	Semester	Paper No.	Course Groups	Credits	Internal marks	External marks	Total marks
M.Sc.	III	I		04	30	70	100
		II		04	30	70	100
		III		04	30	70	100
		IV		04	30	70	100
				08	60	140	200
		TOTAL		24	180	420	800

Master of Science, Organic Chemistry

Semester – III

PAPER-I

Corse Code	Title of The Course	Total credits of Course	Hours of per week
MSC1C301	NATURAL PRODUCTS and BIO-MOLECUALS	4	4hrs

Course Objectives	• To understand the concept of biomolecules and natural products, structural elucidation of natural pigment and alkaloids of different class, their interrelation to each other, synthesis of intermediates and their confirmation through synthetic pathways. • To learn steroids and their respected sex hormones, structural elucidation of steroid molecules, biosynthetic pathways, synthesis of intermediates, steroid based sex hormones and their interrelation to each other, physiological importance, and their synthesis. • To understand biochemical function of vitamins, classification and structural elucidation of vitamins & terpenoids through analytical and synthetic evidence. • To learn about nucleic acid and enzymes. Structural elucidation of DNA, RNA and their role in biochemical function, classification of enzymes &

	their catalytic activities.

Course Content		
Unit	**Description**	**Weightage**
1.	**Natural pigment** Natural colouring matter, general classification, method of synthesis, biosynthesis studies of anthocyanins (cyanine) flavones (chryosin) and flavanol (Querecetin) Porphyrin-structure, isomer, spectral properties and synthesis, General and structure determination of Hemoglobin (Haemin) &chlorophyll .	**25%**
2.	**Alkaloids and vitamins Alkaloids** General biogenetic studies of alkaloids, chemistry of quinine, emetine, strychnine and colchicine Vitamins: Introduction, synthesis and biochemical function of vitamin B1(Thiamine), Vitamin D2 Vitamin C, Biotin and Pantothenic acid.	**25%**
3.	**Steroids and hormones** General biosynthesis studies of steroids, structure of cholesterol and ergosterol, stegmasterol (no synthesis), chemistry of bile acids. Chemistry of androgens, testosterone, estrogens, estrone, estradiol, progesterone their synthesis and biochemical role.	**25%**
4.	**Terpenoids and carotenoids** Classification, nomenclature, general methods of structure determination, chemistry, and synthesis of abietic acid, carvone, cadinene, Farnesol and Zingeberine. Biosynthetic studies on tri-terpenoids andtetra-terpenoids.	**25%**

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	**Details of Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	**30%**
2.	University Examination	**70%**

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the nature of natural pigments & alkaloids, spectral properties of porphyrins, generation of various pyrrole and their carboxylic acid derivatives and their synthesis, structural elucidation of pigments and alkaloids, their analytical evidence for the confirmation of structure including intermediates.
2.	To learn basic skeleton of steroids, structural elucidation of cholesterol, ergosterol, bile acids, male, female sex hormones, their interrelation of each other, corticoids and their physiological activities.
3.	To learn biochemical function of vitamins, classification & structural elucidation, through analytical and synthetic evidence of vitamins and terpenoids, confirmation of intermediates

	through respective synthetic pathway, their respective oxidation, reduction, hydrolysis etc. and rearrangement reactions.
4.	To understand nucleic acids, respective purine and pyridine bases, their interrelation to each other, structural elucidation of DNA & RNA, their classification & nomenclature of enzymes, their next generation, protein synthesis, catalytic activities through various parameters.

Suggested References:

1. Organic chemistry vol I & II (sixth edition) I.L.Finar.
2. Chemistry ofvitamins-S.F.Dyke.
3. Chemistry of natural products by Bantely, Vol1-10.
4. L.J.Wade Jr. Organic chemistry, Prentice nall, England cliffs,1987.
5. Chemistry of Natural products vol I & II byO.P.Agrawal

On-line resourcesto be used if available as reference material.

On-line Resources.

Master of Science, Organic Chemistry

Semester – III

PAPER-II

Corse Code	Title of The Course	Total credits of Course	Hours of per week
MSC1C302	MEDICINAL CHEMISTRY	4	4hrs

Course Objectives	• To understand antibiotics, classification and drug belong to that class, structural variation, synthesis and uses of antibiotics. • To learn about types of antiallergic and antiinfective drugs, their classification, general structures, effect of substituent, SAR, synthesis and uses. • To understand antimalarial drug, life cycle of plasmodium, general classification, their structural variation, synthesis and uses. • To understand life cycle of virus. Various classes of enzymes, general structure of antiviral and anti-HIV agents, structural variation, synthesis and uses.

Course Content		
Unit	**Description**	**Weightage**
1.	**Antibiotics** Antibiotics that interfere with the biosynthesis of bacterial cell wall. A. The β -lactum antibiotics : Penicillin and cephalosporin B. Non lactum antibiotics (only name and structures) C. Bacitracin, vancomycin and cycloserine (only name and structures) Antibiotics that interfere with the protein biosynthesis in microorganisms: non lactum antibiotics, tetracycline, chloramphenicol. Structure actively relationship (SAR) among penicillin's and terramycin. Non classifiable antibiotics (only structure and therapeutic uses) Synthesis of pencillin V, ampicillin, cephalosporin andchloroamphenicol.	**25%**
2.	**Psychoactive drugs** CNS depressant: A. General and localanesthetics B. Sedative and hypnotics Antipsychotic drugs A. Antidepressant B. Neuroleptics Synthesis of the following Thiopental, phenobarbital, Temazepam, Triazolam, alprazolam, glutethimide, nikethamide, chloroprocaine, lidocaine and prilocaine, Ibuprofin, meclofenate sodium, novalgin, pethidine	**25%**
3.	**Antimalarial and Antituberculosis drugs** Antimalarials: Modern chemotherapy of malaria, 4-amino and 8-amino quinolins, 9-amino acridine. Synthesis of quinacrine, chloroquine, primaquine and daraprimMode of action of antimalarial agents SAR of antimalarial agents Anti tuberculosis: Synthesis of only the following drugs: Isoniazid (INH), pyrazinamide, Ethambutol, DDS (Dapsone)	**25%**
4.	Cardiovascular, diuretics and hypoglycemic agents Synthesis of amyl nitrate, diltiazim, propranolol,methyl dopa, tolezamide,carbutamide, glibenclamide, marceline, chlorothiazide,	**25%**

	furosemic and ethacrycnicacid	

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	**Details of Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	**30%**
2.	University Examination	**70%**

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand antibiotics, their classification, general structure, lactum and non-lactum antibiotics, next generation antibiotics, SAR, synthesis and uses of selected drug molecules.
2.	Learn general classification of anti-histamines, anti-mycobacterial and sulphonamides, their structural variations, mode of action and synthesis of selected drug molecules.
3.	Learn life cycle of malaria, types of plasmodia, general structure of anti-malarial agents, structural variation among them, mode of action, synthesis and uses of selected drug molecules.
4.	Understand life cycle of virus. Identification of enzymes responsible for replication of virus, mechanism of drug action. Synthesis and uses of selected drug molecules.

Suggested References:

1. Burger's medicinal chemistry and drug design (5/e) 1997, vol 1 to 5 edited by Manfred E.Woltt (John wiley and sons Mc. Newyork).
2. Principles of medicinal chemistry by William A. Foye (ied), lea and febiys(Philadelphia).
3. Principles of medicinal chemistry vol I & II (5/e) F.S.kadam, K.R. MahadicadK.G.Bohra (Nirali publication).
4. Medicinal chemistry by ashutoshkar.
5. The organic chemistry of drug synthesis vol I, II and III (1980) ed by D. lednicer and L.A. mitscher (Johynwiley and sons, Newyork).
6. Wilson and Gisvold text book of organic medicinal and pharmaceutical chemistry (5/e,1982) by Robert Doerge (J.B. lippincoff company, phaladophia/ Toppan co.Ltd,Tokyo).
7. Topics in medicinal chemistry vol I & II by rabinowitz Myerson (interscience1968).
8. The pharmaceutical basis of theraperutics by Geoman and Gilman (Mcmillanco.)

On-line resources to be used if available as reference material.

On-line Resources.

Master of Science, Organic Chemistry

Semester – III

PAPER-III

Corse Code	Title of The Course	Total credits of Course	Hours of per week
MSC1C303	ORGANIC SPECTROSCOPY	4	4hrs

Course Objectives	• To understand theory and instrumentation of infra-red spectroscopy with working of various parts of instruments. Structure elucidation is also learnt with help of IR spectra. • To learn liquid-liquid chromatography with special focus on the instrumentation of high-pressure liquid chromatography and their application in various field. • To understand the basic concept twelve principle and green solvents and their application. Also learn the uses of various instrumental and classical method in the analysis of water for removal of toxicants. • To understand units of solution their uses in numerical and solution preparation. To understand the uses of non-aqueous titration when aqueoustitration fails and also analysis of C, H, N, O, S with various techniques.

Course Content		
Unit	**Description**	**Weightage**
1.	**UV& IR UV** Electronic transitions, chromophores, auxochromes, bathochromic and hypsochromic shifts, solvent effects, wood ward fieser rules for dienes, enones and aromatic compounds applications, geometric isomers of U.V. instrumentation & diagram. I.R. Vibrational transitions, important group frequencies, factors affecting I.R. group frequency, applications of I.R. instrumentation & diagram. H-bonding & IR spectra.	**25%**
2.	**NMR** Elementary ideas of NMR integration, sample preparation (solid & liquid) chemical shifts, Factors affecting, chemical shifts, coupling (first order, analysis) instrumentation, diagram and principles and instrumentation, FT, chemical shifts, spin-spin coupling different spin systems, mechanism of spin coupling. E.q. AB, ABX, factors affecting vicinal and geminal couplings, rate processes, long range couplings, spin decoupling, deuterium labeling, double resonance, shift reagents, solvent shifts, nuclear overhaulser effect. 2D NMR (COSY and HETCOR)applications.Coupling constant J.	**25%**
3.	C13 NMR and Mass spectrometry C13 NMR: elementary ideas, instrumental problems , Macleferty rearrangement, different between NMR & PMR, chemical shift features of hydrocarbons, effect of substituent on chemical shifts olefinic, acetylenic, aromatic and carbonyl carbons, effects of coupling. Mass spectrometry: theory, instrumentation, modes of ionization, types of detectors, modes of fragmentation. Different types of ions, molecular	**25%**

	ions, isotopic peaks, factors controlling fragmentation, hyphenated mass spectroscopy techniques.	
4.	Structural elucidation of drug molecules based on joint application of UV,IR, PMR, CMR and mass spectroscopy.	**25%**

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	**Details of Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	**30%**
2.	University Examination	**70%**

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the basic concept of Infrared radiation and their interaction with the matter and use of FTIR spectrophotometer in structure identification and quantitative determination.
2.	Recognize the use of different stationary and mobile phase for the separation of organic molecule in liquid chromatography and identify the problems and their solution during the analysis.
3.	Learn different principles of green chemistry and their use in various techniques, also learn the determination of various pollutants in water by different techniques available such as classical and instrumental techniques.
4.	Understand the making of different solution with the help of different concentration and learn the non-aqueous titration when aqueous titration fails. Also learn the determination of various elements in organic compounds.

Suggested References:

1. Spectroscopic methods in organic chemistry, D.H.Williams and Tanfleming.
2. Spectrometric identification of organic compounds, T.C.MorrilR.M.Silverstein and G.Bassler, 6 th edition, John Wiley and sons.
3. Introduction to spectroscopy, D.L.Pavia, G.M.Lampman and G.S.Kriz, 3rd edn, Harcourt college publishers.
4. Organic spectroscopy byW.Kemp.
5. Organic spectroscopy by P.S.Kalsi

On-line resources to be used if available as reference material.

On-line Resources.

Master of Science, Organic Chemistry

Semester – III

PAPER-IV

Corse Code	Title of The Course	Total credits of Course	Hours of per week
MSC1C304	INDUSTRIAL CHEMISTRY	4	4hrs

Course Objectives	• To understand process chemistry and research, basic knowledge of drug discovery, preclinical trail of medicines. Classes of agrochemicals and their properties. • To learn about colour industry-dyes and pigments, nomenclature and colour index, types of dyes, theories of dyes, properties, various types of fibre and miscellaneous applications. • To learn about drug & medicines, nomenclature, generic and trivial name. Various theories of drug action, administration of dyes and determination of physiochemical properties. • To understand unit processes and implementation in industry, determination of various agents in unit process and their synthetic route

Course Content		
Unit	**Description**	**Weightage**
1.	**Basic principles** Basic chemical data, batch versus continuous operation, design, flow charts, chemical process selection, safely, hazardous, fire toxic materials, research and development patents, good manufacturing practice and laboratorypractice.	**25%**
2.	**Unit processes in organic chemistry** (1) Nitration: Nitrating agents. Mechanism of aromatic nitration. Industrial chemicals derived from Benzene, Naphthalene, Anthracene using Nitration. (2)Sulphonation :Sulphonating agents. Mechanism of aromatic Sulphonation. Industrial chemicals derived from Benzene, Naphthalene, Anthracene using Sulphonation., (3) Halogenation: Halogenating agents. Industrial important halogenated compounds derived byvarious routs. (4) Amination: Aminating agents, Amination by reduction, Amination by Ammonolysis. Industrial chemicals derived from Benzene using Amination	**25%**
3.	Green chemistry -12 principles of green chemistry - Greensolvents-aqueous phase reactions Wurtz reaction, witting-Horner reaction, Michael reaction - Solid phase reactions: halogenation, aldol condensation, grignardreaction. - Ionic liquid as green solvent-hydrogenation, diels-alder reaction,Oalkylation and N-alkylation - Green catalysts of green reagents (introduction)	**25%**
4.	Manufacture and uses of -Argochemics (insecticides, fungicides, plant nutrients and plant hormones, Weedicides, pesticides) -Unitoperations	**25%**

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	**Details of Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	**30%**
2.	University Examination	**70%**

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand process chemistry versus research chemistry, concept of clinical trials on various phases, FDA, ADMET, classes of agrochemical-pesticides, herbicides, insecticides and toxicity studies.
2.	Learn colour and chemical constitution, various theories , fastness properties of dyes through various parameters. Application of dyes on various fibres, miscellaneous application of dyes like- non textiles, leather, medicines, photography, cosmetics etc
3.	Understand of drugs, nomenclature & classification, generic and trivial/brand names of drugs, various theories of drug action, biological defence, administration of drug and study their various physico chemical parameters.
4.	Understand unit process & operation. Various unit processes, determination of agents employed in unit process on the basic motif & analogous, establishment of mechanism and their application in industry with different routes.

Suggested References:

1. Unit processes in organic synthesis byP.H.Groggins
2. Industrial Chemical process byR.N.Shreve
3. Riegelshandlook of industrial chemistry ed by James andKent
4. Dryden's outlines of chemical Technology M.GopalRao

On-line resources to be used if available as reference material.

On-line Resources.

Master of Science, Organic Chemistry

Semester – III

PAPER - V & VI

Course Code	**Title of The Course**	**Total credits of Course**	**Hours of per week**
MSC1P301 & MSC1P302	ORGANIC CHEMISTRY PRACTICAL	4	4hrs

Course Content	
1.	Preparation of industrially important compounds by following name reactions (mechanism, purification, and characterization of the synthesized compounds). 1. Sandmeyerreaction 2. Pechmann reaction 3. Skraup synthesis 4. Riemer-Tiemannreaction 5. Kolbe-smithreaction 6. Claisen-smithsynthesis 7. Hoffmanreaction 8. Diels-alder reaction 9. Green –
2.	brominationEstimation 1. Drug assay (estimation of sulphadrug) 2. Non-aqueous titration 3. Nitritevalue 4. Drug dissolution
Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	**Details of Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	**30%**
2.	University Examination	**70%**

Course Outcomes: Having completed this course, the learner will be able to	
1.	**Synthesis work .**

Suggested References:

1. Quantitative analysis by ArtherI.Vogel.
2. Quantitative analysis byV.K.Ahluwalia.
3. Quantitative analysis by Mann andsanders

On-line resources to be used if available as reference material.

On-line Resources.

M.Sc. Semester – IV

(Organic Chemistry)

Sr. No.	Course Title	L	T/C/S	Credit
1.	Advanced Organic Chemistry	4	1	4
2.	Advanced Organic Synthesis	4	1	4
3.	Bio organic Chemistry	4	1	4
4.	Selected topics in Medicinal Chemistry	4	1	4
5.	Practicals	12		8
Total:		28	4	24

External Examination Time: 03hrs

Name of Exam	Semester	Paper No.	Course Groups	Credits	Internal marks	External marks	Total marks
M.Sc.	IV	I		04	30	70	100
		II		04	30	70	100
		III		04	30	70	100
		IV		04	30	70	100
				08	60	140	200
		TOTAL		24	180	420	800

Master of Science, Organic Chemistry

Semester – IV

PAPER-I

Corse Code	Title of The Course	Total credits of Course	Hours of per week
MSC1C401	ADVANCE ORGANIC CHEMISTRY	4	4hrs

Course Objectives	• To understand concept of reactive intermediate and their application in organic synthesis. • To understand basics of pericyclic reaction, familiarize with various theories of pericyclic reaction to access the feasibility of various pericyclic reactions and implant the knowledge to predict stereo chemical outcome of various pericyclic reactions. • To learn anchimeric assistance, stereo chemistry and internal substitution reaction of aliphatic and allylic compounds. Aromatic nucleophilic substitution, cine substitution, elimination reactions, their stereo chemistry and mechanisms. • Understanding of concepts of chirality, topicity, prochirality, dynamic resolutions, types of stereo selective and stereo specific reactions,

	conformation of substituted and fused aromatic rings along with respective strains theories.

Course Content		
Unit	**Description**	**Weightage**
1.	**Pericyclic reactions** Introduction, classification of pericyclic reactions, stereochemistry, molecular orbital symmetry, frontier orbitals of ethylene, 1,3 – butadiene, 1,3,5-hexatriene and allyl system, F.M.O. and PMO approach to cycloaddition and electrocyclic reactions: Generalisation of wood-ward Hoffmann rule, sigma tropic rearrangement-suprafacial and antrafacial shifts of H. Stereoselectivity in sigmatropic rearrangement, enantioselectivity in pericyclic reactions.	**25%**
2.	**Conformational analysis** Confirmation at cyclic systems: Confirmation of cyclohexane, mono, and disubstituted cyclohexane, five and six-membered heterocycles, stereoelectronic effects, fused bicyclic system, decalin, 2-decanol perhydroantracene, perhydro phenanthrene, bridged systems confirmation of sugars, steric strains due to unavoidable crowding, the stereochemistry of the compounds containing nitrogen, sulphur and phosphorous.	**25%**
3.	**Oxidation** Introduction, Oxidation with Cr(VI), Mn(VII), Mn(IV), OsO4, Periodic acid. different oxidation processes, Peroxy acid. hydrocarbons-alkenes, aromatic rings, saturated C-H group (activated and un-activated), alcohols, diols, aldehydes, ketones, amines, hydrazine and sulphides.	**25%**
4.	**Reduction** Introduction, different reductive processes, hydrocarbons-alkanes, alkenes, alkynes and aromatic rings Carbonyl compounds- aldehydes& ketones(LiAlH4, NaBH4 only for aldehyde and ketone) acids and their derivatives, epoxides, nitro, nitroso, azo and oxime groups, Shapiro reduction Preparation and properties and application of pd and Ti compounds as organometallic agents	**25%**

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	**Details of Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	**30%**
2.	University Examination	**70%**

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand generation of reactive intermediates, their mechanism, rearrangement based on

	each intermediate, application of reactive intermediate in organic synthesis and industries application.
2.	Recognise pericyclic reactions, understanding of thermal and photochemical reaction, determination of mechanistic pathway, symmetry properties, aromaticity based on mobius method, application of pericyclic reactions in organic synthesis.
3.	Learn difference between eliminations and addition reaction, concept of anchimeric assistance in various groups like sulphide, halogen, phenyl, hydroxyl, tosylates & mesilates, amino group etc, aromatic nucleophilic substitution through addition elimination, elimination addition, cine substitution and their synthetic application.
4.	Detect chirality in moleculer structure, recognize the relationship between enantiomeric and diastereomeric structures, understand and distinguis stereoselective and stereospecific reactions, dynamic resolution, confirmative study of various substituted aromatic and fused aromatic rings and their application in pharmaceutical industry.

Suggested References:

1. Advance organic chemistry by JerryMarch.
2. Advance organic chemistry by Carey andSundberg.
3. Advance organic chemistry by Francis A.carey

On-line resources to be used if available as reference material.

On-line Resources.

Master of Science, Organic Chemistry

Semester – IV

PAPER-II

Corse Code	Title of The Course	Total credits of Course	Hours of per week
MSC1C402	**ADVANCED ORGANIC SYNTHESIS**	**4**	**4hrs**

Course Objectives	• To understand the reaction mechanism of a chemical reaction, the path and the feasibility of a reaction, reactivity of a group and need to understand preferential group, suitable reagent and appropriate condition. • To understand the synthetic pathway, breaking and assembling molecules, suitable reagent, to suggest synthetic route for complex organic compounds with stereochemistry. • To learn ring synthesis based on retrosynthetic pathway, application of various name reactions, generation of intermediates and their involvement in the construction of ring and generation of aromatic compounds from heterocycles. • To learn about organometallic chemistry, synthesis of hydrocarbon, olefin, transformation of various functional group, name reactions based on organometallic compound, their mechanism and synthetic applications.

Course Content		
Unit	**Description**	**Weightage**
1.	**Protection of groups** Principle of Protection of alcohols, Carbonyl, Carboxylic acid and amino groups, with different reagents and their de-protection, Synthetic equivalent groups and examples on transformations, synthetic analysis and planning, control of stereochemistry.	**25%**
2.	**Disconnection approach** An introduction to synthesis, and synthetic equivalents, disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis one group C-X and two group C-X disconnections, chemo-selectivity, reversal and polarity.	**25%**
3.	**One group C-C disconnections** Alcohols and carbonyl compounds, region-selectivity, alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis.	**25%**
4.	**Ring synthesis** Synthesis of Saturated heterocycles, synthesis of 3, 4, 5, and 6-membered rings, aromatic heterocycles in organic synthesis. Synthesis of alkanes and cycloalkanes from thiophene, Synthesis of alkenes and cyclo alkenes from pyridines.	**25%**

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	**Details of Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	**30%**
2.	University Examination	**70%**

Course Outcomes: Having completed this course, the learner will be able to	
1.	Focus on the protecting and deprotecting groups with various organic scaffolds, choose of reagents, solvents and synthetic pathway, the reactions of group and their synthetic applications.
2.	Understand deep aspects of retrosynthesis and oxidation-reduction reaction, assumption of synthetic equipment and design the novel route for the synthesis target.
3.	Understand synthesis of various rings based on retrosynthetic pathway, application of reactive intermediate in the synthesis of ring, can be able to design new molecules of interest and generation of aromatic hydrocarbons from various heterocycles.
4.	Learn the Role of organometallic compounds in organic synthesis, reduction, oxidation, transformation of a group, application in pharmaceutical industries for the synthesis of pharmaceutically active agents.

Suggested References:

1. Organic synthesis: the disconnection approach by stuart Warren (wiley studentedition)
2. Organic chemistry- clayden, greeves, warren and wothers, (oxfordpress)

On-line resources to be used if available as reference material.

On-line Resources.

Master of Science, Organic Chemistry

Semester – IV

PAPER-III

Corse Code	Title of The Course	Total credits of Course	Hours of per week
MSC1C403	BIO-ORGANIC CHEMISTRY	4	4hrs

Course Objectives	• To learn multicomponent reaction, alkene formation, asymmetric synthesis, amide formation, role of intermediate in synthesis, transformation and study their mechanism. • Role of various oxidizing agents in organic synthesis, chemoselectivity, factors affecting oxidation reaction, study their working mechanism and various applications. • ole of various reducing agents in organic synthesis, chemoselectivity, factors affecting reduction reaction, study their working mechanism and various application. • Study of cationotropic, aniontropic migration, involvement of reactive intermediate in various rearrangement, migrating aptitude of various groups.

Course Content		
Unit	**Description**	**Weightage**
1.	**Water and vitamins** Water –interaction among biomolecules in aqueous systems, buffering against pH changes, in biological systems, participation of water in biological reactions. Vitamins-classification, introduction, chemistry, absorption transport, mobilization and biochemical functions of Vitamins A, D, E, K, C, B, B2, B6, H and folic acid	**25%**
2.	**Proteins and enzymes Proteins** properties and conventions of common amino acids, stereoisomerism in	**25%**

	α -amino acid, peptides: formation, compositions and sizes of protein separation, purification and characterization, sequencing of peptides, sanger's method, edman degradation, outline of other methods, protein sequences and evolution. Oxygen binding proteins, haemoglobin and myoglobin in oxygen transport and storage. Enzymes: classification, nomenclature and extraction factors affecting catalytic activity and specificity in action, regulation of enzyme activity, enzyme inhibition, illustrative enzymatic reactions using chymotrypsin, hexokinase, enolase and lysozyme	
3.	**Carbohydrates and nucleic acid** **Carbohydrates:** classification and stereochemistry, biologically important hexose derivatives, the nomenclature of disaccharides, structure, and role of some homo and heteropolysaccharides, **glycoconjugates:** proteoglycans, glycoproteins and glycolipids **Nucleic acid:** compounds of nucleic acids, nomenclature of nucleotides, nucleosides, structure of DNA and structure of RNA	**25%**
4.	**Lipids** Nomenclature, structure and physical properties of some naturally occurring fatty acids, triacelglycerol and waxes as sources of stored energy, insulation of water repellants, types of membrane lipids, introduction to glycerophospho lipids, galactolipids, sphingo lipids, phospholipids and sterols, bile acids.	**25%**

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	**Details of Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	**30%**
2.	University Examination	**70%**

Course Outcomes: Having completed this course, the learner will be able to	
1.	To learn type of transformation, intermediate step. Types of multicomponent reaction, insitu reaction, role of reactive intermediate in transformation, types of asymmetric synthesis, alkene formation reaction, base catalyzed reaction, mechanism of reaction and their synthetic applications.
2.	To learn the role of various oxidizing agents, study chemoselectivity, mechanism of reaction, transformation of group, name reactions based on various oxidizing agents and their synthetic applications.
3.	To learn about role of various reducing agents, chemoselectivity, mechanism of reaction, transformation of group, name reactions based on various reducing agents and their synthetic applications.
4.	To learn about type of rearrangement, migrating aptitude, ring expansion, contraction, strain theory, isotopic effect, effect of other groups with reference to functional group and their application.

Suggested References:

1. Principles of biochemistry –Donald J.Voet, JudishG.Voet, charlotte w. pratt (John willey and sons).
2. Lehninger principles of biochemistry- David L.Nelson and Michael M.wx (PalgraveMacmillan / w.h. freeman company new york).
3. Biochemistry – U.SatyanarayanaBaro and allied P.Ltd.,kolkata

On-line resources to be used if available as reference material.

On-line Resources.

Master of Science, Organic Chemistry

Semester – IV

PAPER-IV

Course Code	Title of The Course	Total credits of Course	Hours of per week
MSC1C404	SELECTED TOPICS IN MEDICINAL CHEMIEMISTRY	4	4hrs

Course Objectives	• To understand antibiotics, classification and drug belong to that class, structural variation, synthesis and uses of antibiotics. • To learn about types of antiallergic and antiinfective drugs, their classification, general structures, effect of substituent, SAR, synthesis and uses. • To understand antimalarial drug, life cycle of plasmodium, general classification, their structural variation, synthesis and uses. • To understand life cycle of virus. Various classes of enzymes, general structure of antiviral and anti-HIV agents, structural variation, synthesis and uses.

Course Content		
Unit	**Description**	**Weightage**
1.	**Drug design**: Introduction, naming of organic medicinal compounds, literature of medicinal chemistry, development of new drugs, procedure followed in drug design, concept of lead compound and lead modification, pro drugs, soft drugs, phase I, II and III clinical trials, structure activity relationship, theories of drug activity: occupational theory, rate theory, induced fit theory, quantitative structure activity relationship, history and development of QSAR. Concept of drug receptors, elementary treatment of drug receptor interactions, physio chemical parameters lipophilicity, partition coefficient, electronic ionization constant, concept of 3-DQSAR.	**25%**
2.	**Pharmacokinetic and pharmacodynamics** Pharmacokinetics: introduction to drug absorption, distribution, metabolism, elimination. important pharmacokinetic parameters in defining drug deposition and in therapeutics uses of pharmaceutics in	**25%**

	drug development process Pharmacodynamics: Introduction, elementary treatment of enzyme stimulation, enzyme inhibition, drug metabolism, biotransformation, the significance of drug metabolism in medicinal chemistry.	
3.	Dosage forms, Quality control and application of computers in chemistry Dosage forms, types of dosages, different roots of administration, quality control of drugs pharmacopias, modern methods of pharmaceutical analysis. Computer in chemistry Use of computer in chemistry and industry Important websites for data search chemistry Information about online journals for chemistry	**25%**
4.	Overview, Medicinal use of nanomaterials-Drug delivery Protein and peptide delivery –cancer, surgery, visualization, nanoparticle targeting Medical application of molecular nanotechnology-nanorobots, cell repair machines, Nano nephrology.	**25%**

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	**Details of Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	**30%**
2.	University Examination	**70%**

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand antibiotics, their classification, general structure, lactum and non-lactum antibiotics, next generation antibiotics, SAR, synthesis and uses of selected drug molecules.
2.	Learn general classification of anti histamines, anti-mycobacterial and sulphonamides, their structural variations, mode of action and synthesis of selected drug molecules.
3.	Learn life cycle of malaria, types of plasmodia, general structure of anti malarial agents, structural variation among them, mode of action, synthesis and uses of selected drug molecules.
4.	Understand life cycle of virus. Identification of enzymes responsible for replication of virus, mechanism of drug action. Synthesis and uses ofselected drug molecules.

Suggested References:

1. Burger's Medicinal Chemistry and Drug Discovery (5/e), 1997, Vol. 1, 2, 3, 4,5, Edited by ManFred E. Wolff (John Wiley & Sons, inc., NewYork).
2. Wilson and Gisvold's Text-book of Organic Medicinal and Pharmaceutical Chemistry (5/e, 1982) by Robert F. Doerge (J. B. Lippincott Company, Philadelphia/Toppan Co. Ltd.,Tokyo).
3. Principles of Medicinal Chemistry, Vol. I & II (5/e), by S. S. Kadam, K. R. Mahadik, K. G. Bothra (NiraliPrakashan).

4. QSAR: quantitative structure-activity relationships in drug design by Jean-Luc Fauchère. ISBN:084515141X, 9780845151419
5. QSAR : Hansch analysis and related approaches By HugoKubinyi

On-line resources to be used if available as reference material.

On-line Resources.

Master of Science, Organic Chemistry

Semester – IV

PAPER - V (PRACTICALS)

Course Code	Title of The Course	Total credits of Course	Hours of per week
MSC1P401	**ORGANIC PREPARATION AND ESTIMATION PRACTICAL**	**4**	**4hrs**

Course Objectives	• To impart basic knowledge for carrying out multistep synthesis based on some name reactions. • Understand nature of reaction and establishment of reaction condition with mechanism • To learn about the calculation of mole ratio for each reaction. • Isolation of product from individual step, purification and confirmation of the product. • To understand the purpose of green synthesis.

Course Content	
1.	Preparation of industrially important compounds by following name reactions (mechanism, purification and characterization of the synthesized compounds) 1. Sandmeyer reaction 2. Pechmann reaction 3. Skraup synthesis 4. Riemer-Tieman reaction 5. Kolbe-smith reaction 6. Claisen-smith synthesis 7. Hoffman reaction 8. Diels-alder reaction 9. Green – synthesis
2.	Bromination Estimation 1. Drug assay (estimation of sulphadrug) 2. Non-aqueous titration 3. Nitrite value 4. Drug dissolution
Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops,

	presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	**Details of Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	**30%**
2.	University Examination	**70%**

Course Outcomes: Having completed this course, the learner will be able to	
1.	Establish mechanism and monitoring reaction at specified reaction condition.
2.	Learn to work-up after the completion of reaction, purification.
3.	Confirmation of product through the references.
4.	Learn to interpret structure of organic compounds from given spectra.
5.	Understand the calculation with reference to respective factors.
6.	Appreciate good laboratory practices.

Suggested References:

1. Quantitative analysis by ArtherI.Vogel.
2. Quantitative analysis byV.K.Ahluwalia.
3. Quantitative analysis by Mann andsanders

On-line resources to be used if available as reference material.

Master of Science, Organic Chemistry

Semester – IV

PAPER - V (TRAINING)

Course Code	**Title of The Course**	**Total credits of Course**	**Hours of per week**
MSC1P402	**INDUSTRIAL TRAINING**	**4**	**4hrs**

Evaluation Pattern		
Sr. No.	**Details of Evaluation**	**Weightage**
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	**30%**
2.	University Examination	**70%**

Course Outcomes: Having completed this course, the learner will be able to	
1.	Industrial training use full know how chemistry use full in different types of industry's .