Name of Program	**Master of Science(Chemistry)**
Abbreviation	**M.Sc.**
Duration	**2 Years**
Eligibility Criteria	**M.Sc. Chemistry** **(Organic/Inorganic/ Analytical/Physical)** ELIGIBILITY:(SC/ST- 35%, OPEN/SEBC-40%), A candidate who has obtained his/her Bachelor's Degree with chemistry shall be considered eligible for admission in M .Sc .Chemistry **M.Sc. (Organic Chemistry** ELIGIBILITY :(SC/ST- 35%, OPEN/SEBC-40%), A candidate who has obtained his/her Bachelor's Degree with chemistry shall be considered eligible for admission in M.Sc.- Chemistry/Organic Chemistry. **M. Sc .Environmental Chemistry** ELIGIBILITY :(SC/ST- 35%, OPEN/SEBC-40%) A candidate who has obtained his/her Bachelor's Degree with chemistry shall be considered eligible for admission in M.Sc.- Chemistry/Organic Chemistry (SF.)/ Environmental Chemistry (S.F.) Course. **M.Sc. Organic Chemistry (Evening)** ELIGIBILITY :(SC/ST- 35%, OPEN/SEBC-40%) A candidate selecting M.Sc. Evening course (2 years) with Organic Chemistry as specialization must have passed the Bachelor's Degree examination with Chemistry and English as compulsory subject. Those who are in service will have to produce minimum one year's experience certificate from the Employer.
Objective of Program	The core objective of the M.Sc. programme is to prepare the students for dynamic career in industry and academia by providing an excellent environment of teaching and research in the core and emerging areas of the discipline.
Program Outcome	PO1: To enhance the knowledge of chemistry domains and become master in respective branch of chemistry. To be able to communicate clearly and effectively with in and across disciplinary lines. PO2: Built up entrepreneurship ability by taking advantage of industrial hub in periphery of our university. PO3: Establishment of research center with the aid of interdisciplinary subject being run in university. PO4: Persuasion of doctoral degree in the concern subject and further study. PO5 : Development of related short term courses related to demanded subject in anticipation of strengthening knowledge and application PO6: Training/internship of students for employment in public sector, private sector and national laboratories. PO7: Participation in scientific discussions showing respect and lead 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 lead interdisciplinary work with experts from other fields. PO10: To understand and adopt the best safety practices in research.
Program Specific Outcomes	Students need to build up 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 scientific temper, communicate scientific information in a clear, concise and precise manner. PSO2 : Find job opportunities at all level of chemical industries(dyes & pharmaceutical), national laboratories & research centers. PSO3 : Apply the knowledge in sustainable and eco friendly technologies. PSO4 : Inculcate logical thinking to addressess the problem and become result oriented. PSO5 : Development of research culture in persuasion of Ph.D. program at national & international institute/university. PSO6 : Participate in specific competitive examination conducted by various public service commission and other public sector. PSO7 : Develop and apply the fundamental knowledge to build small scale industry in context to Atma Nirbhar 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 research culture and implementation of policies at global & local level. PSO10 : Communicate scientific information clear 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 : Will build new scientific understanding as it provides students the opportunity to articulate their thinking as they engage in the science practices during an investigation.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
PO1		■	■				■	■	■	■		
PO2	■		■		■		■	■	■	■		■
PO3	■		■	■	■				■	■	■	■
PO4	■	■	■	■			■		■	■	■	■
PO5		■	■	■			■			■		■
PO6	■		■	■	■				■	■		■
PO7		■	■	■	■			■		■		■
PO8	■	■		■		■	■	■	■		■	■

	PO9												
	PO10												
Medium of Instruction	English												

Structure of M. Sc, Syllabus
Semester-I

Sr. No.	Course Code	Course Title	L	T/C/S	Credit
1	1803080201010001	Inorganic Chemistry	4		4
2	1803080201020001	Organic Chemistry	4		4
3	1803080201030001	Physical Chemistry	4		4
4	1803080201040001	Instrumental and chemical analysis	4		4
5		Practicals + T/C/S	12	3	6 + 3
			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

Master of Science, Inorganic Chemistry
M.Sc. Inorganic Chemistry, Semester I

Course Code	[1803080201010001]	Title of the Course	**INORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

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.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content		
Unit	Description	Weightage* (%)
1.	**SYMMETRY AND GROUP THEORY IN CHEMISTRY AND ITS APPLICATIONS** Representation of Group: preparation of matrics and vectors matrix notation for geometric transformation, Orthogonality theorem and its consequences, reducible and irreducible representation and their relation, preparation of character table for C_{2v} and C_{3v} point groups, applications of group theory transformation properties of atomic crystals.	25

2.	**QUANTUM MECHANICS** Discussion of solution of Schrodinger equation to same model system e.g. the one dimensional harmonic oscillator, two particle rigid rotator. Ordinary angular momentum, generalized angular momentum, Eigen functions of angular momentum, eigen values of angular momentum, different types of operators and their uses, addition of angular momentum, spin, Russell-Saunders terms and coupling scheme, term separation energies of the p^n and d^n configuration, magnetic effect: spin orbit coupling and Zeeman effect(splitting)	25
3.	**INORGANIC REACTION MECHANISM** Labile and inert complexes, factors responsible for lability and inertness of complexes. Reactivity of metal complexes, ligand replacement reaction: classification of mechanism and energy profile of reaction. Inert and labile complexes, interpretation of liability and inertness of transition metal complex on the basis of reaction rate, VBT and CFT. Transition state or activated complex, substrate, attacking regents electrophilic and nucleophilic, nature central atom. Kinetic application of CFT. Kinetics of octahedral substitution, acid hydrolysis, factor affecting acid hydrolysis, base hydrolysis conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism.	25
4.	**METAL CLUSTERS** Introduction, classification, carbonyl cluster, low nuclearity carbonyl clusters, high nuclearity carbonyl clusters, electron counting scheme for HNCCS, Wade's rules. Halides types clusters: dinuclear clusters, trinuclear clusters, tetranuclear clusters, hexanuclear cluster. Chevrel phases and zintl ions, Carboranes, metalloboranes, metallo carboranes, higher boranes(hexaborane-10, decaborane-14), number and types of bonds present in higher boranes.	25

Teaching-Learning 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 Pattern		
Sr.	Details of the Evaluation	Weightage

No.		
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the of matrices and vectors matrix notations, reducible representation and their relation, applications of group theory
2.	Learn regarding quantum mechanics, angular momentum, understanding the solution of Schrodinger equation, Different types of operators and their uses
3.	Learn different types of inorganic reaction mechanism, acid hydrolysis, base hydrolysis . conjugate base mechanism their synthetic application
4.	Understand the introduction and classification of metal clusters, electron counting scheme for HNCCS and Wade's rule and their synthetic application

Suggested References:

1. Chemical applications of group theory by F.A Cotton (Second edition), Wiley Eastern Limited, 1976 New Delhi
2. Group theory and its application by P.K. Bhattacharya, Himalaya publishing hours, Mumbai, 1986
3. Group theory and symmetry by L. R. hall, McGraw hill, New York, 1989.
4. Quantum Chemistry by Ira N. Levine, Prentice-Hall of India Pvt. Lid, New Delhi, 1994.
5. Introductory Quantum Chemistry (Third edition) by N. W. Hanna, Benjamin, Menlo Park, Cailf, 1988.
6. Quantum Chemistry and Spectroscopy by M. S. Pathania, Vishal Publications, India, 1981.
7. Kinetic and Mechanism' by A. A. Frost and R. G. Pearson, Wiley, New York, 1953, 1961.
8. Mechanism of Inorganic Reactions by F. Basolo and R.G. Pearson, Second Edition, Wiley Eastern Limited, New Delhi, 1977.
9. Advanced Inorganic Chemistry by F. A Cotton and R.G. Wilkinson, John Wiley & Sons, N. Y.
10. Principales of Inorganic Chemistry, by Puri. Sharma and Kalia, 33rd Edition, Vishal publishing Co. Jalandhar, Dehli, 2017.
11. Advanced Inorganic Chemistry by S. K. Agarwala and Keemtilal, Pragati Prakashan, Meerut.
12. Advanced Inorganic Chemistry, Volume-Il by Gurdeep Raj, Krishna Prakashan Media Ltd., Meerut.
13. Inorganic Chemistry by Gary L Miessler and Donald A. Tarr, Pearson Education

International.

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

Master of Science, Inorganic Chemistry
M.Sc.Inorganic Chemistry, Practicals

Course Code	[1803081001050001]	Title of the Course	**INORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

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.
Mapping between CO and PSO	
	•

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■
CO5	■	■	■	■			■		■	■	■	■

Course Content

1. Inorganic Qualitative Analysis: (Six elements including ONE rare element)
2. Inorganic Preparation.
   - I. Hexa-ammine nickel (II) chloride
   - II. Mohr's salt (Ferrous Ammonium sulphate)
   - III. Sodium trioxalato ferrate trihydrate
   - IV. Sodium cobaltinitrite

V. Tetra amine cupric sulphate
VI. Reineck's salt (Ammonium tetrathiocyanate diammine Chromate)

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

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	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.
4.	Identify each cation and confirm it by confirmative test.
5.	Understand different methods of Preparations of inorganic salts.
6.	Appreciate good laboratory practices.

Suggested References:

1. Textbook of practical inorganic chemistry – A.I. Vogel
2. Practical Chemistry by Dr O. P. Pandey, D. N. Bajpai, Dr. S. Giri
3. Advance inorganic analysis by Agarwal, Keemti lal
4. Qualitative Inorganic analysis - Vogel
5. Inorganic practical by Chatwal and Anand

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

On-line Resources

Master of Science, Organic Chemistry
M.Sc. Organic Chemistry, Semester I

Course Code	[1803080201020001]	Title of the Course	**ORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

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 reaction 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.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content		
Unit	Description	Weightage* (%)
1.	**REACTION MECHANISM & REACTIVE INTERMEDIATES** Detailed study of organic reaction intermediates. Generation, structure, stability and reactions of –	25

	Carbocations (Classical and non-classical): Phenonium ion, norbornyl system, common carbocation rearrangements- Demjanov, Pinacole-Pinacolone, Rupe. **Carbanions:** Mechanism of condensation involving enolates - Aldol, Claisen, Mannich, Dieckmann, Michael and Shapiro reactions. **Carbenes:** Mechanism of Arndt-Eistert reaction, Reimer-Tiemann reaction and Bamford Steven's rearrangement reaction. **Free Radicals:** Allylic halogenation (NBS), coupling of alkenes and arylation of aromatic compounds by diazonium salts. Sandmeyer reactions. Free radical rearrangements, Hunsdiecker reaction.	
2.	**PERICYCLIC REACTIONS** **Introduction** - Definition, Characteristics and Classification Molecular orbitals and symmetry properties of ethylene, 1,3-butadiene, 1,3,5- hexatriene and allylsystems. **Electrocyclic Reactions:** Woodward-Hoffman Correlation diagram and derivation of selectionrules Conrotatory and disrotatory motions, FMO and PMO approach for 4n and (4n+2)Πelectron system and allyl systems. **Cycloaddition Reactions** : Antarafacial and suprafacial additions. FMOand PMO approach for 4n and (4n+2)Πelectron Systems(No correlation diagram),Diels-Alder reaction, stereoselectivity,Effect of substituents. **Sigmatropicrearrangements:**Suprafacial and antarafacialshifts involving H & C moieties, retention and inversion of configurations. The Cope and Claisen rearrangements, Ene reaction, 1, 3- dipolar cydoadditions. Examples of electrocyclic, cycloaddition and sigmatropic rearrangements.	25
3.	**SUBSTITUTION AND ELIMINATION REACTIONS** **A: Aliphatic Nucleophilic Substitution:** The SN1 , SN2 , SNi mechanisms. Reactions of Allylic halides, neighbouring group participation by -OH, -NH2, -COO- , -RS, - halogen, aromatic ring. **B: Aromatic Nucleophilic Substitution:** The SN2 , SN1 and benzyne mechanisms, Reactivity - effect of substrate structure, leaving group and attaching nucleophile, The Von Richter rearrangement. **C: Elimination reaction:** Hoffmann and Zaitsev's rule of elimination, E1, E2 and E1CB Reaction mechanism and orientation.	25
4.	**STEREOCHEMISTRY:** Stereo chemical principles; Enantiomeric relationships; Distereomeric relationship; R-S and E-Z nomenclature; Dynamic stereochemistry; Chiral-Prochiral relationships; Stereo selective and Stereo specific reactions; Racemates and racemic modification, Resolution of racemic modification, Optical activity in the absence of chiral carbons biphenyl, allenes, spiranes. **B.** Confirmational Analysis: Interconversion of Fischer, Newman and Sawhorse projections. Newer method of asymmetric synthesis	25

	(including enzymatic and catalytic nexus), enantio and diastereo selective synthesis.Simple acyclic and cyclic (chair and boat cyclohexanes, Decalins, Perhydrophenanthrene)systems Effects of conformation on reactivity in acyclic compounds and substituted cyclohexanes.	

Teaching-Learning 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 Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	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 h stereoselective and stereospecific reactions, dynamic resolution, confirmative study of various substituted aromatic and fused aromatic rings and their application inn pharmaceutical industry.

Suggested References:

Unit I:

1. Carbenes, Benzynes and Nitrenes by Gilchrist, T. L. and Rees.
2. Advanced Organic Chemistry-Reactions, Mechanism and Strucuture, Jerry March, John Wiley.
3. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
4. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S. Rammond (McGraw-Hill Book Co. &Kogekusha Co. Ltd., 1970).
5. Organic Chemistry (5/e) by Morrison & Boyd (Prentice Hall).
6. Advanced Organic Chemistry by Carey &Sundberg (3rd edition).
7. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
8. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.
9. Organic chemistry 2nd ed. Jonathan clayden, Nick greeves, Stuart Warren.
10. Reaction Mechanism and Reagents in Organic Chemistry by C. R. Chatwal (Himalaya Publishing House, Bombay, 1987).

UNIT II:

1. March's Advanced Organic Chemistry Reactions, Mechanisms, And Structure 7th ed. 2013 Michael B. Smith. Wiley.
2. Mechanism AndTheory In Organic Chemistry-2007 by Thomas H. Lowry, Kathleen S. Richardson, Forbes.Harper& Row, Publishers. New York, Hagerstown, San Francisco, London.
3. Advanced Organic Chemistry Part A: Structure and Mechanisms by Carey &Sundberg (5th edition),2000, Springer.
4. Pericyclic Reactions, S. M. Mukherji, Macmillan, India.
5. Photochemistry AndPericyclic Reactions 3rd ed. by Jagdamba Singh 2010. New Age International Publishers Ltd. New Delhi.
6. Pericyclic Reactions A mechanistic and problem solving approach Sunil Kumar, Vinod Kumar, S.P.Singh Academic Press 2015

UNIT III:

1. Advanced Organic Chemistry-Reactions, Mechanism and Strucuture, Jerry March, John Wiley.
2. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
3. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S. Rammond (McGraw-Hill Book Co. &Kogekusha Co. Ltd., 1970).
4. Organic Chemistry (5/e) by Morrison & Boyd (Prentice Hall).
5. Organic Chemistry by Carey &Sundberg (3rd edition).
6. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
7. Physical organic chemistry by Jack Hyne
8. Reaction mechanism by Jagdambasingh.
9. Organic chemistry - Reaction mechanism, by P.S. Kalsi, New age international publishers.

UNIT IV:

1. Advanced Organic Chemistry: Part A: Structure and Mechanisms; By Francis A. Carey, Richard J. Sundberg, fifth edition, Published by Springer.

2. Advanced Organic Chemistry: Part B: Reaction and Synthesis; By Francis A. Carey, Richard J. Sundberg, fifth edition, Published by Springer.
3. Stereochemistry of Carbon Compounds; By Ernest L. Eliel, Published by Tata McGraw-Hill Publishing Company Ltd.
4. Basic organic stereochemistry; By Ernest Ludwig Eliel, Samuel H. Wilen, Michael P. Doyle, Published by Wiley-Interscience.
5. Introduction to Stereochemistry; By Kurt Martin Mislow, Dover Publication INC.
6. Stereochemistry of Organic Compounds: Principles and Applications; By D. Nasipuri, New Age International (P) Ltd. Publisher.
7. Stereochemistry Conformation and Mechanism; By P.S. Kalsi, New Age International (P) Ltd. Publisher.
8. Basic Stereochemistry of Organic; By SubrataSen Gupta, First edition, Published by Oxford University Press.

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

Master of Science, Organic Chemistry
M.Sc.Organic Chemistry, Practicals

Course Code	[1803081001050001]	Title of the Course	**ORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To impart basic knowledge for the separation of organic ternary mixture • To identify nature of mixture i.e., solid-solid, solid-liquid, liquid-liquid etc. • To impart knowledge of different purification techniques including distillation. • Separation and identification of component with their functional group test and M.P. /B.P. • To confirm the structure and prepare the relevant derivative.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■

	CO4 ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ CO5 ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■

Course Content

3. Mixture analysis: (Minimum eight mixtures) Ternary mixture to be given. (S+S+S), Semisolids or (L+L+L). Type, determination, Separation by physical and chemical methods. (both permitted in case of liquids)
4. Paper Chromatography

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

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

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Understand basics of separation of organic tertary mixtures.
2.	Identify and chemical nature of mixture.
3.	Separate of each component from mixture.
4.	Identify each component through their functional group test, elemental analysis and M.P/BP.
5.	Purify the compounds using different techniques including distillation, crystallization etc.
6.	Record physical constants for individual compounds.

7.	Appreciate good laboratory practices.

Suggested References:
1. A text book 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.
On-line resources to be used if available as reference material
On-line Resources

Master of Science, Physical Chemistry
M.Sc.Physical Chemistry, Semester I

Course Code	[1803080201030001]	Title of the Course	**PHYSICAL CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

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
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■

CO4													
CO5													

Course Content		
Unit	Description	Weightage* (%)
1.	**CHEMICAL KINETICS** Theories of Unimolecular gas reactions: Lindemann theory, Kinetics of some complex reactions (i)Reversible reactions(only first order opposed by first order) (ii)Consecutive reactions(A→B→C); Steady state treatment or approximation, Enzyme catalysed reactions, Kinetics of general Chain reaction, Kinetics of photochemical reactions(H_2-$Cl_2$and H_2-Br_2) , Kinetics , Mechanism ,determination of activation energy and chain length of some organic decomposition (i) decomposition of ethane (ii) decomposition of acetaldehyde, Effect of Ionic strength on rates of ionic reactions (Primary and secondary salt effect) Numerical.	25
2.	**THERMODYNAMICS** Introduction to Laws of thermodynamics, state and path functions and their applications, thermodynamic description of various types of processes,Maxwell's relations, Partial molar quantities, Calculation of partial molar quantities, determination of partial molar volume and partial molar enthalpy, Ideal and non-ideal liquid mixtures,Thermodynamics functions of mixing of non-ideal solutions (i) free energy of mixing (ii) entropy of mixing (iii) volume of mixing and (iv) enthalpy of mixing ,Excess functions(μ^E,G^E , S^E ,H^E and V^E) for non-ideal solutions and expression for excess thermodynamic functions. Numerical	25
3.	**STATISTICAL THERMODYNAMICS** Basics of Statistical Thermodynamics (Assembly,Canonica l ensemble, occupation numberstatistical weight factor, probabilit y) , Thermodynamic probability,Probability and entropy, Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics. Lagrange's methods of multipliers, Partition function,Thermodynamic properties in term of partition functions(i) Internal energy (ii) Heat Capacity (iii) Third law of thermodynamics(iv) Helmholtz free energy (v) Enthalpy (vi) Gibb's free energy(vii) Chemical potential (viii) Equilibr ium constant Molecular partition functions for an ideal gas , Derivation for Translational, Rotationaland Vibrational partition functions Numerical.	25

4.	**POLYMER CHEMISTRY** Types of polymers, Stereochemistry of polymers, Kinetics of polymerization (Addition and Condensation),Thermodynamics of polymerization, Phase techniques of polymerization (Bulk, solution, suspension and emulsion), Number & Mass average Molecular mass, Polydispersity Index (P.D.I) Molecular mass determination by Viscometry and Osmometry, Thermal transitions in polymer: glass transition temperature and its significance, Numerical	25

Teaching-Learning Methodology	classroom teaching, use of e-resources, library books , IT tools, encouraging students to participate in seminars/ workshops, presentations by students, assignments etc.

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

Course Outcomes: Having completed this course	
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:

Unit I:

1. Chemical Kinetics, Laidler K.J. TATAMcGRAW-HILL PUBLISHING COMPANY LTD

2. Principles of Chemical Kinetics, James E. House, Elsevier Publication
3. Kinetics and Mechanism of Chemical Transformations, Rajaraman, J. and Kuriacose, J., McMillan (2008)b
5. Engel, T. & Reid, P. Physical Chemistry, Pearson
6. Maron, S. & Prutton Physical Chemistry

UNIT II:

1. Thermodynamics for chemist Samuel Glasstone, East-West Press Pvt. Ltd. (2008)
2. Physical Chemistry, Volume 1: Thermodynamics and Kinetics (10th Edition) by Professor Peter Atkins, Julio De Paula
3. Principles of Physical ChemistryPuri B.R., Sharma L.R. and Pathania, M.S., Vishal Publishing Co
4 A Text Book of Physical chemistry K.L.Kapoor Vol-5 Macillan India Ltd. 2007
5 An Introduction to Chemical Thermodynamics R P Rastogi and R R Mishra VIKASH PUBLISHING HOUSE PVT LTD. 6th edition
6 Advanced Physical Chemistry D.N.Bajpai S.CHAND& COMPANY LTD. 2nd EDITION

UNIT III:

1. Statistical Thermodynamics BY M. C. Gupta New Age International, 2007
2. An Introduction to Statistical Thermodynamics, Terrell L. Hill, ADDITION WESLAY PUBLISHING COMPANY
3. Principles of Physical Chemistry Puri B.R., Sharma L.R. and Pathania, M.S., Vishal Publishing Co
4. A Text Book of Physical chemistry K.L.Kapoor Vol-5 Macillan India Ltd. 2007

UNIT IV:

1. Polymer science by V.R.Gowarikar. WILEY EASTERN LTD
2. Principal of polymer chemistry by A. Ravve, Springer
3. A Textbook of Polymer Chemistry, M S Bhatnagar, S Chand Publications.
4. Principles of Physical Chemistry Puri B.R., Sharma L.R. and Pathania, M.S., Vishal Publishing Co

Master of Science, Physical Chemistry
M.Sc. Physical Chemistry, Practicals

Course Code	[1803081001050001]	Title of the Course	**PHYSICAL CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

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
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■
CO5	■	■	■	■			■		■	■	■	■

Course Content

1. Determine the dissociation constant and strength of borax solution pH-metrically.
2. Determine the velocity constant of the hydrolysis of ethyl acetate with sodium hydroxide at room temperature by conductance measurements.
3. Determine the solubility of silver chloride in water potentiometrically.
4. To determine the concentration of given components in a mixture colorimetrically.
5. Determine the equilibrium constant of the reaction $I^- + I_2 = I_3^-$ by distribution method.

6. Investigation the reaction between H2O2 and HI at two different temperatures and calculate the energy of activation for the reaction
7. Determine the formula of a complex between Cu+2and NH3 by distribution method.
8. Determine CST of Phenol -Water system
9. Determine CST of Phenol –NaCl system

Teaching-Learning Methodology	Introduction, explanation of theory and procedure of the experiments and interpretation of results.

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

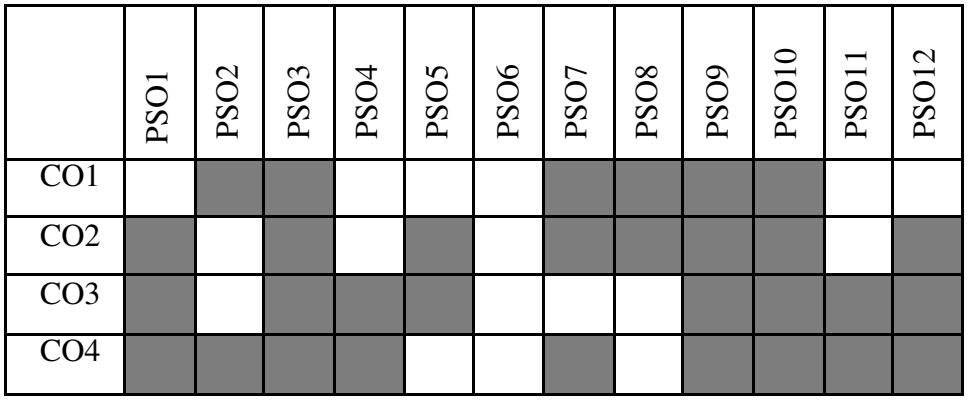
Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Understand preparation of solutions.
2.	Qualitative analysis of compound
3.	calculate the concentration of unknown solution by pH, potentiometer and colorimeter
4.	Understand behaviour of surfactant and polymer
5.	Separation of solvent using phase diagram

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.
4. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson

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

Master of Science, Instrumental and Chemical Analysis
M.Sc. Analytical Chemistry, Semester I

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.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Code	[18030802010040001]	Title of the Course	**INSTRUMENTAL AND CHEMICAL ANALYSIS**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Content		
Unit	Description	Weightage* (%)
1.	**UV-VISIBLE SPECTROPHOTOMETRY** Types of electronic transition, auxochrome, chromophore, Bathochromic effect, Hypso chromic effect, Hyper chromic effect, Hypo chromic effect, Factor affecting λ_{max} like resonance, hyper conjugation, hydrogen bonding, steric effect, Woodward's rules for α, β-unsaturated ketones, Diene systems, aromatic system, Effect of solvent on absorption bands, law of absorption with derivation, Elementary idea of double beam automatic recording, Spectrophotometer, Application.	25
2.	**CHROMATOGRAPHY** **Thin-Layer Chromatography:** Selection of stationary and mobile phase, Detection techniques – Elementary idea of HPTLC **Gas Chromatography:** Selection of mobile phase – Selection of stationary phase in GLC and GSC – Detectors: FID (with modifications), TCD and ECD, Their comparison, Packed column, WCOT, SCOT (advantages and disadvantages) –Temperature programming – Derivatisation in GC – Quantitative Analysis.	25
3.	**CHEMICAL MATHEMATICS** Errors in Chemical analysis, classification of errors, nature and origin of errors, Propagation of error, Accuracy and precision, Average deviation and standard deviation and its physical significance, Normal Distribution curve and its properties. Confidence limit and probability, Statistical treatment for error analysis, students't' test, rejection criteria and Q test, method of least square	25
4.	**THERMAL METHODS OF ANALYSIS** **(A) THERMOGRAVIMETRY** Thermogravimetry, Instruments for TGA- thermobalace and furnace, Calibration of temperature scale, Factors affecting TGA results instrumental and experimental, Applications. **(B) THERMOMETRIC TITRATION:** Thermometric Titration (TT), Advantages, Instrument, Applications of TT in Neutralization Titration, Precipitation Titration, Complexometry Titration and Redox Titration.	25

Teaching-Learning 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.

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 identified by the techniques.
3.	Learn difference between different types of errors observed during analysis and use of statistical treatment of data. Also learn to accept and reject the data with help of different type of tests.
4.	Use of the thermometric techniques when the other methods are failed. The requirement of the techniques and identified the problems arise during the analysis.

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Suggested References:

1. Fundamental of molecular spectroscopy, C. N. Banwell, Tata McGraw Hill Pub. Camp.
2. Spectrometric Identification of Organic Compounds (4^{th} edition/5^{th} edition), Silverstein, Bassler & Morril, John Wiley & Sons.
3. Introduction to Molecular Spectroscopy, G. M. Barrow, McGraw – Hill.
4. Modern Spectroscopy, J.M.Hollas, John Wiley.
5. Basic Principles of Spectroscopy, R.Chang, McGraw-Hill.
6. Modern Methods of Chemical Analysis (2^{nd} ed.), Pecsok, Shields, Cairns & McWilliom, John Wiley & Sons.
7. Instrumental Analysis by R. D. Braun, McGraw-Hill.

8. Mathematics for Chemistry, Doggett and Sucliffe, Longman.
9. Mathematical preparation for Physical Chemistry, F. Daniels, McGraw Hill.
10. Introduction to Instrumental Analysis by R. D. Brawn, McGraw-Hill Book.
11. Fundamentals of Analytical Chemistry: Skoog D. R. and West D. M. (Holt, Rinehart & Winston, New York).
12. Chemical Analysis in Industry (in Gujarati) by M. N. Desai.
13. Instrumental Methods of Analysis by G. W. Ewing.
14. Modern Method of Chemical Analysis by Pecsok, Shield, Cairns, McWilliam, John Wiley and Sons.
15. Quantitative Analysis, 6th Ed., R. A. Day and A. L. Underwood, Prentice – Hall of India, 1993.
16. Instrumental Analysis: G. D. Caristian and J. E. O'Reilly (Allyn & Bacon Inc., New York, 2nd edition.
17. Instrumental Methods of Chemical Analysis: G. W. Ewing (McGraw-Hill, New York), 5th edition.
18. Instrumental Methods of Analysis: H. R. Willard, L. L. Merrit, J. A. Dean, F. A. Settle (Van Nostrand Reinhold Co., New York), 6th edition.
19. Modern Methods of Chemical Analysis: Pecsok, Shield & Cairns (John Wiley), 2nd edition.
20. Introduction to Instrumental Analysis (1987), R. D. Braun (McGraw-Hill Book Company), New Delhi.
21. Analytical Chemistry: Principles and Techniques: Larry G. Hargis (Prentice-Hall International edition).
22. Introduction to Modern Liquid Chromatography: L. R. Shyder & J. J. Kirkland (John Wiley & Sons, New York).
23. Treatise on Analytical Chemistry: I. M. Kohthoff & P. J. Elving (John Wiley & Sons, New York).
24. Handbook of Analytical Chemistry: L. Meites (McGraw-Hill, New York).

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

Structure of M. Sc, Syllabus
Semester-II

Sr. No.	Course Code	Course Title	L	T/C/S	Credit
1	1903080202010001	Inorganic Chem	4		4
2	1903080202020001	Organic	4		4
3	1903080202030001	Physical	4		4
4	1903080202040001	Instrumental and chemical analysis	4		4
5		Practicals + T/C/S	12	3	6 + 3
			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

Master of Science, Inorganic Chemistry
M.Sc.Inorganic Chemistry, Semester II

Course Code	[1903080202010001]	Title of the Course	**INORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To learn the properties of non-transition metal elements. • To learn the synthesis, bonding, properties and applications of main group elements. • To understand the Bio inorganic chemistry of Hemoglobin, Myoglobin, Ferritin and Transferrin • To understand the metal complexes in Medicine and anticancer activity of Platinum complexes
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content

Unit	Description	Weightage* (%)
1.	**ELEMENTS OF MAGNETOCHEMISTRY** Definitions of magnetie properties, type of magnetic bodies, the source of paramagnetism, diamagnetism and pascal's constant, Example of pascals constant. Curie and Curie-Weiss law, Magnetic Properties of transition elements. Determination of magnetic susceptibility: (a) Gouy method (b) Faraday method (s) Null deflection method Application of magnetic susceptibility measurements, Temperature independent paramagnetism (TIP), Orbital contribution to magnetic moment	25
2.	**METAL π - COMPLEXES** **Metal carbonyls:** Introduction, classification of metal carbonyls, structure and bonding. vibrational spectra studies for bonding and structure elucidation. Preparation of metal carbonyls by (1) Direct synthesis and (2) From metal compounds. preparation Properties and structure of $Ni(CO)_4$ $Fe_2(CO)_9$ and $Co_2(CO)_8$, 18-electron rule and EAN of metal carbonyls **Metal Nitrosyls** : Introduction, coordination compounds of metal nitrosyls, preparation properties of nitrosyl compounds like nitrosyl halides, nitrosyl cyanides, hydroxides and nitrosyl aquo compounds Complex of NO^+ iron, EAN and structures of nitrosyls.	25
3.	**INORGANIC POLYMERS** Definition of polymers and their depiction. Characteristics of inorganic polymer. Characterization of inorganic polymers (physical properties) by molecular weight, number average and weight average. Structural features of polymers: (1) Backbone bonding (2) Branching and cross-linking (3) Chemical and Stereo chemical variability Classification of inorganic polymers, synthesis, properties, structures uses and application of polyphosphazenes and polysiloxanes.	25
4.	**COORDINATION COMPOUNDS** Classification of coordination compounds, Werner's theory of coordination, Electronic interpretation of coordination compounds, Factors effecting the formation of complex ions, Detection of complex ion in solution, Chelation, Factors influencing the stability of metal chelates, Importance of chelates, Role of metal chelates in living system and	25

	polynuclear complexes, Determination of composition of complex ions	

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 the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the definitions of magnetic properties, type of magnetic bodies, determination of magnetic susceptibility and its applications.
2.	Understand, classification of metal carbonyls and nitrosyls, structure and bonding. Vibrational spectra studies for bonding and structure elucidation, preparation of metal carbonyls and nitrosyls.
3.	To learn the characteristics of inorganic polymer and characterization of physical properties by molecular weight, number average and weight average. Structural features of polymers by different bonding.
4.	Understand the classification of coordination compounds, Werner's theory, Electronic interpretation, factors effecting the formation of complex ions, detection of complex ion in solution, stability of metal chelates and Importance of chelates, role of metal chelates in living system

Suggested References:

1. Magneto chemistry by R. L Carlin
2. Element of Magnetochemistry by A. Syamal and R. L. Dutta, Affileted East-West press,

new Delhi, 1993.
3. Introduction to metal pi-complex chemistry by M. Tsusui, M. lchikwa, K. Mori, Plenum press, New york
4. Introductory polymer chemistry by G. S Mishra, Wiley Eastern Ltd,1993.
5. Phosphorous-Nitrogen Compounds, H. R. Allock, Academic, New York, 1972.
6. Advanced in Inorganic Chemistry by S. K. Agarwal, Keemtilal, Pragati prakashan, Meerut
7. Coordination Chemistry by Ajaykumar, Aaryush Education publication, Thind publication
8. Principles of inorganic chemistry by Puri, Sharma and Kalia, Vishal publication Co. Jalandhar, Delhi
9. Coordination Chemistry by Gurdeep Chatwal, M.S. Yadav, Himalaya Publishing house
10. inorganic polymers by Prof G. R. Chatwal, Himalaya Publishing House

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

Master of Science, Inorganic Chemistry
M.Sc.Inorganic Chemistry, Practicals

Course Code	[19030811002050001]	Title of the Course	**INORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To impart basic knowledge for carrying out analysis of alloy. • Understand the types of complexometric titrations • To understand and calculate the percentage purity of salt. • Determination of physical constant and confirmation of product. • Concept of estimation and determination of each radical quantitatively and qualitatively.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												

	CO4 ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ CO5 ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■

Course Content

Quantitative Analysis :

1. Analysis of Solder and Type metal (Alloy Analysis)
2. Determine the amount of Ca as $CaC_2O_4H_2O$ or as $CaCO_3$, in limestone
3. Estimation of Cu^{+2} as CUSCN
4. Estimation of Iron in Iron ore
5. Estimation of available chlorine in bleaching powder
6. Estimation of Ca^{+2} and Pb^{+2} in Admixture
7. Determine the amount of Fe^{+3} and Cr^{+3} Present in given Admixture
8. Determine the percentage purity of the given sample of Manganese salt
9. Estimation of Aluminium by back titration.

Teaching-Learning Methodology	Introduction, interaction with students in calculation of mole ratios, Carrying out experiments at each step according to the respective practical.

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

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the analysis of alloy and ore and calculation of molarity and mole ratio.
2.	Learn to methods to find copper, zinc gravimetrically and volumetrically.
3.	Learn to find available chlorine bleaching powder.
4.	Learn to determine calcium, lead, Iron and chromium in admixture,

5.	Appreciate good laboratory practices.

Suggested References:

1. A textbook of practical inorganic chemistry - A.L.Vogel
2. Practical Chemistry by Dr.O.P.Pandey, D.N.Bajpai, Dr.S.Giri
3. Advance inorganic analysis by Agarwal, Keemti lal
4. Qualitative Inorganic analysis – Vogel
5. Inorganic practical by Chatwal and Anand

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

On-line Resources

Master of Science, Organic Chemistry
M.Sc.Organic Chemistry, Semester II

Course Code	1903080202020001	Title of the Course	**ORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To learn transition metal catalyst based on C-C, C-N coupling reaction, formylation reaction, various acid base catalyzed condensation reactions, reactions which changes configuration etc. and their mechanism. • To learn aromaticity based on different concept, measurement of aromaticity through various parameters, annulenes, azzulene and types of aromaticity. • To understand the role of chemical reactants in oxidation, reduction, dehydration, cyclisation and transformation of various organic functional groups. • To understand photochemistry, various types of its reaction, photochemical cleavage of carbonyl compounds, their mechanism and application in synthesis.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												

	CO2 ■ □ ■ □ ■ □ ■ ■ ■ ■ □ ■ CO3 ■ □ ■ ■ ■ □ □ □ ■ ■ ■ ■ CO4 ■ ■ ■ ■ □ □ ■ □ ■ ■ ■ ■

Course Content		
Unit	Description	Weightage* (%)
1.	**Organic Name Reactions** General nature, method, mechanism and synthetic applications of the following reactions: (i) Heck reaction (ii) Dakin reaction (iii) Darzen'sglycidic ester synthesis (iv) Leuckart reaction (v) Suzuki reaction (vi) Willgerodt reaction (vii) Buchwald-Hartwig reaction (viii) H. V. Z reaction (ix) Vilsmeyer-Hack reaction (x) Mitsunobu reaction (xi) Sonagashira reaction (xii) Dickmann reaction.	25
2.	**AROMATICITY** A. Aromaticity and Aromatic character; structure and stability of benzene, Frost circle diagram, concept of aromaticity; Resonance and chemical stabilization; criteria to checkaromatic character-IR, NMR, heat of hydrogenation; Huckel's rule; HMO method B. Antiaromaticity, homoaromaticity, nonaromaticity; aromaticity in benzanoid compounds: naphthalene, pyrene, acepleialdelene. C. Aromaticity non-benzenoid compounds: azulene, tropolones, charged rings,annulenes fullerenes, and hmesoionic compounds.	25
3.	**ORGANIC TRANSFORMATION AND REAGENTS** I. Sharplessepoxidation II. Umpolung reagent (1,3-dithiane) III. Dess martin periodinane IV. DDQ V. Tri-n-butyltinhydride (C4H9)3SnH VI. Diisobutyl aluminum hybride (DIDAL-H) VII. Lithium disoprpyl amide (LDA) VIII. OZONE / IX. K3Fe(CN)6and DMSO X. Merrifield Peptide Synthesis\	25

	XI. Crown ethers XII. Wilkinson's Catalyst	
4.	**PHOTO CHEMISTRY** A. Energy of molecules, photochemical energy, electronic excitation, Jablonski diagram, laws of photochemistry, quantum efficiency. B. Photochemistry of carbonyl compounds- α- cleavage of acyclic, cyclicand α-β unsaturated cleavage of carbonyl compounds, β-cleavage of, inter and intramolecularhydrogen abstraction, addition to carbon- carbon doublr bond, photo reduction of carbonylcompounds. C. Photo induce rearrangement of enones, dienones and alkenes. Photochemistry of alkenesand aromatic compounds- isomerization, dimerization and addition reactions D. Photochemistry of visiob, singletoxygenoxygenations,solar energy conversion and storage	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 the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the role of transition metal in organic synthesis by studying Heck, Suzuki, Sonogashira and Buchwald Hartwing reaction, formylation by Villsmayer Heck reaction, substituted amines, amides formation reaction, cyclisation through condensation reaction and inverted configuration through Mitsunobu reaction.
2.	Understand aromaticity, various parameters for the measurement of aromaticity, frost circle method and calculation of energy for the determination of aromaticity.

	Aromaticity measurement through NMR, types of aromaticity and aromaticity measurement in fused rings, annulenes and azulenes etc
3.	To learn the chemistry involved in oxidation-reduction reactions by employing numerous reagents & appropriate chemo-selectivity of the reagents, suggest use of miscellaneous reagents in organic synthesis including Wilkinson catalyst, DIBAL-H, PTC-crown ether, 1,3-Dithiane etc.
4.	Get one self familiarize with usual photochemical reactions, terms of photochemistry, understanding fluorescence, phosphorence by photoexcitation decay/discipation of energy. Types photochemical reactions like Norrish type-I & II, Paterno-Buchi etc., Photodimensation and their application in organic synthesis.

Suggested References:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
3. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S. Rammond (McGraw-Hill Book Co. &Kogekusha Co. Ltd., 1970).
4. Organic Chemistry (5/e) by Morrison & Boyd (Prentice Hall).
5. Advanced Organic Chemistry by Carey &Sundberg (3rd edition).
6. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
7. Name Reactions by A. R. Parikh &H.A.Parikh
8. Name reaction: A collection of detailed reaction machanisms by Jie Jack Li
9. Reaction Mechanism and Reagents in Organic Chemistry by C. R. Chatwal (Himalaya Publishing House, Bombay, 1987).
10. Organic Chemistry-Reactions and Mechanism by P S Kalsi
11. Advanced Organic Chemistry : Reactions and Mechanisms byM.S. Singh
12. Organic chemistrybyCram, Hammond, Pine and Handrickson
13. Photochemistry and Pericyclic Reactions by Jagdamba Singh
14. Pericyclic reactions: A text book by S. Sankararaman
15. Excited states in Organic Chemistry by J. D. Coyle and J. A. Barltrop
16. March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure by Michael B. Smith
17. Advanced Organic Chemistry: Part B: Reaction and Synthesis byCarey & Francis
18. Organic Chemistry byJonathanClayden

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

On-line Resources

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Master of Science, Organic Chemistry
M.Sc.Organic Chemistry, Practicals

Course Code	[19030811002050001]	Title of the Course	**ORGANIC CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

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 each reaction. • Isolation of product from individual step and purification by crystallization. • Determination of physical constant and confirmation of product. • Concept of estimation and determination of each component quantitatively.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												
CO4												

Course Content

Preparation of organic compounds :

i) Nitration
ii) Bromination
iii) Acylation
iv) Reduction
v) Oxidation
vi) Condensation reaction
vii) Diazotization reaction
viii) Friedl-Craft's reaction
ix) Cannizzaro reaction
x) Aldol condensation

Quantitative Estimations

a. Estimation of ester + acid
b. Estimation of formaldehyde
c. Estimation of glycine
d. Estimation of amide + acid

Teaching-Learning Methodology	Introduction, interaction with students in calculation of mole ratios, Carrying out experiments at each step according to the respective practical.

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

Course Outcomes: Having completed this course, the learnerwill 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 monitora 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 text book 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.

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

Master of Science, Physical Chemistry
M.Sc. Physical Chemistry, Semester II

Course Code	[1903080202030001]	Title of the Course	**PHYSICAL CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To learn conductivity behaviour of strong electrolytes in solution, factors affecting electrolysis process. • To learn basics and application of colloids. • To understand the basics of surface chemistry. • To understand basics of molecular spectroscopy.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content		
Unit	Description	Weightage* (%)
1.	**UNIT-I:THEORIES OF ELECTROLYTIC CONDUCTANCE AND OVER VOLATEGE** Debye-Huckel theory of strong electrolytes, relaxation effect and electrophoretic effect, Debye Falkenhagen effect, Weineffect.Ionic strength and its determination ,Debye-Huckel limiting law. Activity and activity coefficient,	25

	determination of activity coefficient by (i) solubility (solubilit y product principle) (ii) EMF method (cell without transference), Determination of dissociation constant of monobasic acid by conductance method and approximate EMF method, Electrolytic polarization, Dissolution and Decomposition potential, Concentration polarization, Decomposition potential and its determination, over voltage, determination of over voltage,theories of over voltage:combination of atom as slow process (Tafel theory) Numerical.	
2.	**UNIT-II: SURFACE CHEMISTRY** Adsorption Multilayer Adsorption, the BET adsorption isotherms, derivation of BET equation, determination of surface area and area of cross section of molecules by BET equation.Derivation of Langmuir equation from BET equation. Explanation of different adsorption isotherms, Change in enthalpy ,entropy and free energy of adsorption, Adsorption at the surface of liquid : Gibbs adsorption isotherms (derivation).Thermodynamic treatment of adsorption,Surface –Active substances, orientations of surfactants on the surface of solution , surface inactive substances, surface pressure,Insoluble surface films on liquid Numerical	25
3.	**UNIT-III: COLLOIDS:** Types of colloidal systems, preparation of lyophobic colloidal, Properties of Colloidal systems: (i) electrical properties origin of charges on colloidal, electrical double layer, Zeta potential and its determination by electrophoresis, factor affecting zeta potential, explanation on DLVO theory of colloid stability (ii) Electrokinetic properties: Electrophoresis, elecroosmosis. Surface active agents, critical micellar concentration (CMC), factors affecting the CMC of surfactants, thermodynamics of micellization: mass action and phase separation model, solubilisation, emulsion, types of emulsion, methods for determination of types of emulsion, microemulsion, types of microemulsion, theories of microemulsion.	25
4.	**UNIT IV: MOLECULAR SPECTROSCOPY** Molecular spectra, Microwave spectroscopy (Rotational spectroscopy): The Rotation of molecules, Linear molecule, Symmetric tops ,Spherical tops, Asymmetric tops, Rotational spectra of rigid diatomic molecule ,Intensities of spectral lines , Effect of isotopic substitution, Techniques and instrumentation of rotational spectrum, IR Spectroscopy: Classical frequency of harmonic oscillator,The classical potential energy of harmonic vibration of a diatomic molecule, Quantum expression of potential energy, energy level diagram, Relative population of energy levels ,Mechanism of	25

	interaction with radiation, selection rule, determination of force constant, Amplitude of vibration, The anharmonicvibrationor oscillator , Morse potential , Vibrational energy of diatomic molecule following the Morse potential, energy level diagram, vibrational transitions. Vibrational –Rotational spectra of diatomic molecule(CO molecule) Application of Vibrational rotational spectra Numerical	

Teaching-Learning Methodology	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 the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Understand the electrolytes in conductance of solutions. Importance of polorizat ion decomposition potential and over voltage in electrolysis process and in industries
2.	Understand physical phenomena of surface chemistry. Application of surface active substance and factor affecting surface chemistry, adsorption of surface active materials
3.	Understand the solution behaviour of surfactants. Colloidal chemistry explain the importance of micelle formation for colloidal industry
4.	Identify the molecular interactions and concentration and identification of componds

Suggested References:

UNIT : 1.

1. Atkins, P.W., Physical Chemistry, W.H. Freeman (2017) 10 th editon
2. Samuel Glsstone, Introduction to Electro chemistry, East-West Press Pvt. Ltd. (2008)
3. Puri, B.R., Sharma, L.R., and Pathania, M.S., Principles of Physical Chemistry, Vishal Publishing Co.
4. Engel, T. & Reid, P. Physical Chemistry, Pearson
5. Barrow, G.M. Physical Chemistry Tata McGraw Hill (2007)
6. Maron, S. & Prutton Physical Chemistry, Collier Macmillan Ltd

UNIT : 2

1. Puri, B.R., Sharma, L.R., and Pathania, M.S., Principles of Physical Chemistry, Vishal Publishing Co.
2. Engel, T. & Reid, P. Physical Chemistry, Pearson
3. Barrow, G.M. Physical Chemistry Tata McGraw Hill (2007)
4. Maron, S. & Prutton Physical Chemistry, Collier Macmillan Ltd

UNIT : 3

1. Puri, B.R., Sharma, L.R., and Pathania, M.S., Principles of Physical Chemistry, Vishal Publishing Co.
2. Engel, T. & Reid, P. Physical Chemistry, Pearson
3. Maron, S. & Prutton Physical Chemistry, Collier Macmillan Ltd
4. Colloid Science: Principles, Methods and Applications by T Cosgrove
5. Physical Chemistry of Surfaces" by A W Adamson and A P Gast

UNIT 4

1. Fundamentals of Molecular Spectroscopy C N Banwell TATA McGRAW-HILL15th edition
2. Handbook of Molecular Spectroscopy, by D.N. Sathyanarayana
3. Introduction to Spectroscopy by Donald L. Pavia, George S. Kriz, Gary M. Lampman, James R. Vyvyan
4. Fundamentals of molecular spectroscopy by Walter S. Struve
5. Barrow, G.M. Physical Chemistry Tata McGraw Hill (2007)

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

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Master of Science, Physical Chemistry
M.Sc. Physical Chemistry, Practicals

Course Code	[19030811002050001]	Title of the Course	**PHYSICAL CHEMISTRY**
Total Credits of the Course	4	Hours per Week	4 hrs

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
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■
CO5	■	■	■	■			■		■	■	■	■

Course Content

1. Determine the dissociation constant and strength of borax solution pH-metrically.
2. Determine the velocity constant of the hydrolysis of ethyl acetate with sodium hydroxide at room temperature by conductance measurements.
3. Determine the solubility of silver chloride in water potentiometrically.
4. To determine the concentration of given components in a mixture colorimetrically.
5. Determine the equilibrium constant of the reaction I- + I2 = I3- by distribution method.
6. Investigation the reaction between H2O2 and HI at two different temperatures and calculate the energy of activation for the reaction
7. Determine the formula of a complex between Cu^{+2} and NH_3 by distribution method.
8. Determine CST of Phenol -Water system
9. Determine CST of Phenol –NaCl system

Teaching-Learning Methodology	Introduction, explanation of theory and procedure of the experiments and interpretation of results.

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

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand preparation of solutions.
2.	Qualitative analysis of compound
3.	calculate the concentration of unknown solution by pH, potentiometer and colorimeter
4.	Understand behaviour of surfactant and polymer
5.	Separation of solvent using phase diagram

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.
4. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson

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

Master of Science, Instrumental and Chemical Analysis
M.Sc. Analytical Chemistry, Semester II

Course Code	1903080202040001	Title of the Course	**INSTRUMENTAL AND CHEMICAL ANALYSIS**
Total Credits of the Course	[1903080202040001]	Hours per Week	4 hrs

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 aqueous titration fails and also analysis of C, H, N, O, S with various techniques.

Mapping between CO and PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												

	CO2 ■ □ ■ □ ■ □ ■ ■ ■ ■ □ ■ CO3 ■ □ ■ ■ ■ □ □ □ ■ ■ ■ ■ CO4 ■ ■ ■ ■ □ □ ■ □ ■ ■ ■ ■

Course Content		
Unit	Description	Weightage* (%)
1.	**IR SPECTROSCOPY*:*** Introduction: Theory, Instrumentation: single beam, double beam spectrophotometers, FTIR: principle , instrument design, and function of beam splitter, radiation sources, sample cells, monochromators, detectors, sample handling, Resolution, wave number measurement, Advantages of FTIR vs. IR. Useful terms: IR region, types of vibrations: fundamental and overtones, linear and nonlinear molecule, equation for vibrational frequency, selection rule, coupling interactions, hydrogen bonding information, Fermi resonance. IR spectra: group frequency, group frequency region, finger print region, spectra interpretations and structure elucidation.	25
2.	**LIQUID CHROMATOGRAPHY** Principle of Liquid – Solid chromatography, Comparison with GC, Column chromatography, Gradient elution, Displacement chromatography, Principle of HPLC, Instrument and significance of each component, Pumps, Guard column Criteria in selection of mobile phase, Stationary phases (solid, liquid), Bonded phase supports, Detectors: UV absorption, RI detectors – Normal phase and Reversed phase. Method of introducing sample.	25
3.	**GREEN CHEMISTRY AND WATER ANALYSIS** **(A) Green Chemistry** Twelve principles, green solvents and their applications: Ionic liquids, types, properties and applications, ILs as solvents, Supercritical fluids, Supercritical CO_2, its properties and applications in dry cleaning and decaffeination of coffee. **(B) Water analysis** Sources of water pollution, Sewage and industrial effluents, Analysis of water pollutants, Sampling, Preservation, Measurement of parameters such as COD, BOD, DO, TDS, suspended solids, TCC, phenols, fluoride.	25

4.	**TITRIMETRIC METHODS AND ELEMENTAL ANALYSIS** **Solution and Their Concentration:** Molarity, Molality, Normality, ppm, ppb, ppt, %w/v, %w/w, %v/v, Formality, Primary and Secondary standard, Acid Value, Density and Specific Gravity, Numerical. **Non-Aqueous Titration:** Protic and Aprotic Solvent, Solvent system, Dielectric constant, Titrant, Titration Curve, Determination of Equivalence point, Karl Fisher Titration, Numerical. **Elemental Analysis:** Step on Analysis, C and H Analysis, N Analysis, Halogen Analysis and Sulpher Analysis, Numerical.	25

Teaching-Learning 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 Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written Examination (As per CBCS R.6.8.3)	30%
3.	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. Fundamental of molecular spectroscopy, C.N. Banwell, Tata McGraw Hill Pub. Camp.
2. Spectrometric Identification of Organic Compounds (4th edition/5th edition), Silverstein,Bassler&Morril,JohnWiley&Sons.
3. IntroductiontoMolecularSpectroscopy,G.M.Barrow, McGraw – Hill.
4. Modern Spectroscopy, J.M.Hollas, John Wiley.
5. Basic Principles of Spectroscopy, R.Chang, McGraw-Hill.
6. ModernMethodsofChemicalAnalysis(2nd ed.),Pecsok,Shields,Cairns&McWilliom, JohnWiley&Sons.
7. Instrumental Analysis byR. D. Braun, McGraw-Hill.
8. Mathematics for Chemistry, Doggett and Sucliffe, Longman.
9. Mathematical preparation for Physical Chemistry, F. Daniels, McGrawHill.
10. Introductionto Instrumental Analysis by R. D. Brawn, McGraw-Hill Book.
11. FundamentalsofAnalyticalChemistry:SkoogD.R.andWestD.M.(Holt,Rinehart&Winston, New York).
12. Chemical Analysis in Industry(in Gujarati) by M. N. Desai.
13. Instrumental Methods of Analysis by G. W. Ewing.
14. ModernMethodofChemicalAnalysisbyPecsok,Shield,Cairns,McWilliam,John Wiley and Sons.
15. Quantitative Analysis, 6th Ed.,R.A.DayandA.L.Underwood, Prentice– Hall of India, 1993.
16. Instrumental Analysis: G. D. Caristian and J. E. O'Reilly (Allyn& Bacon Inc., NewYork, 2ndedition.
17. Instrumental Methods of Chemical Analysis: G. W. Ewing (McGraw-Hill, NewYork), 5thedition.
18. Instrumental Methods of Analysis: H. R. Willard, L. L. Merrit, J. A. Dean, F. A. Settle (Van Nostrand Reinhold Co., New York), 6thedition.
19. Modern Methods of Chemical Analysis: Pecsok, Shield & Cairns (John Wiley), 2ndedition.
20. Introduction to Instrumental Analysis (1987), R. D. Braun (McGraw-Hill Book Company), New Delhi.
21. Analytical Chemistry: Principles and Techniques: Larry G. Hargis (Prentice-Hall International edition).
22. Introduction to Modern Liquid Chromatography: L. R. Shyder& J. J. Kirkland (John Wiley & Sons, New York).
23. Treatise on Analytical Chemistry: I. M. Kohthoff& P. J. Elving (John Wiley & Sons, New York).
24. Handbook of Analytical Chemistry: L. Meites (McGraw-Hill, New York).
25. Environmental Chemistry: B. R. Sharma, H. Kaur (Goel Publishing House, Meerut).
26. Environmental Chemistry by A.K.de

27. Spectrometric Identification of Organic Compounds; By Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce, Eight edition, Published by Wiley
28. Introduction to Spectroscopy; By Donald L. Pavia, Gary M. Lampman, George S. Kriz, James A. Vyvyan,Fourth edition, Published by Brooks cole.
29. Spectroscopic Methods in Organic Chemistry; By D.H Williams, I. Fleming, Sixth edition, Published by Tata Mcgraw Hill Education.
30. Spectroscopy of Organic Compounds; By P S Kalsi, Sixth edition, Ne Age International Publisher.
31. Organic Spectroscopy: Principles and Applications; By Jag Mohan, Second edition, Published by Alpha Science International Ltd.
32. Organic Spectroscopy (NMR, IR, Mass and UV); By Dewan S.K.,First edition, CBS Publisher & Distributors Pvt Ltd.
33. Basic Principles of Spectroscopy; By Raymond Chang, Published by McGraw-Hill Inc.
34. Elementary Organic Spectroscopy; By Y R Sharma, S. Chand & Company Pvt. Ltd.
35. Organic Spectroscopy; By William Kemp, Published by Palgrave Macmillan.

36. Green chemistry by V. K. Ahluwalia, Narosa Pub New Delhi
37. Green Chemistry, Theory and Practice, P. T. Anastas and John C. Warner, Oxford University Press, 2000, New York, USA.
38. Green Chemistry: An Introductory Text, Mike Lancaster, Green Chemistry Network, University of York, RSC, 2002.

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

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

M.Sc. Semester-III (ORGANIC CHEMISTRY)

Sr. No.	Course Title	L	T/C/S	Credit
1	Natural Products and Bio-molecules	4	1	4
2	Selected Topics In Organic Chemistry-I	4	1	4
3	Organic Chemistry in Industry	4	1	4
4	Medicinal Chemistry-I OR Dye and Intermediates-I	4	1	4
5	Practicals	12		8
		28	4	24

External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No	Course group	Credit	Internal Marks	External Marks	Total Marks
M. Sc.	III	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	08	60	140	200
			Total	24	180	420	600

Master of Science, Organic Chemistry
M.Sc.Organic Chemistry, Semester III
PAPER-I

Course Code	[1903080203010003]	Title of the Course	**Natural Products and Bio-molecules**
Total Credits of the Course	4	Hours per Week	4 hrs

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 evidences. • To learn about nucleic acid and enzymes. Structural elucidation of DNA, RNA and their role in biochemical function, classification of enzymes & their catalytic activities.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content		
Unit	Description	Weightage* (%)
1.	**NATURAL PIGMENTS and ALKALOIDS** **(A) Natural Pigments and Porphyrins Derivatives** Porphyrins: General structures, Synthesis and Spectral properties. Synthesis of cryptopyrrole, Phytopyrrole, Opsopyrrole and Haemopyrrole and their carboxylic acid derivatives. Structural elucidation of Haemoglobin and Chlorophyll (Analytical evidences only) **(B) Alkaloids** Classification of alkaloids; Structural elucidation of Morphine, Reserpine and Colchicine (Analytical evidences only)	25
2.	**STEROIDS and SEX HORMONES** **(A) Steroids**	25

	Introduction to Sterols: Structure determination of cholesterol and ergosterol (no synthe sis), Bile acids: Introduc tion, Structura l elucida tion and Synthe sis of Chola n ic acids (α and β both). **(B) Sex Hormones** Classification of hormones: Structure and synthesis of Androgens, Oestrogens and Gestrogens. Name and structures of Adrenocortical hormones, Partial synthesis of cortisone.	
3.	**VITAMINS and TERPENOIDS** **(11 Periods)** **(A) Vitamins** Structure determination, Synthesis andbiochemical functions of Vitamin A,Vitamins B1 andB2, Vitamin H **(B) Terpenoids** Classification, nomenclature and isolation Structure determina tion and synthesis of Farnesol, Zingibe re ne, Cadine ne, Gibrelic acid and Abietic acid.	25
4.	**Nucleic Acids & Enzymes** **(A)Nucleic Acids** Purine and pyrimidine bases of nucleic acids, base pairing via H-bonding, Chemical and enzymatic hydrolysis of nucleic acids, Structure of nucleosides and nucleotides, DNA, RNA(Basics structures only), DNA replication, Transcription, Translation, Protein Biosynthesis. **(B) Enzymes** Classification, nomenclature and inhibition, factors affecting catalytic activity and specificity in action, regulation of enzyme activity	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 the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learnerwill 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 evidences 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 evidences 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:

Reference Books Recommended:

1. Organic Chemistry, Vol. I & II (Sixth edition), I. L. Finar.
2. S.W. Pelletier, Chemistry of the Alkaloids, Van Nostrand Reinhold Co., New York (1970).
3. K.W. Bentley, The Alkaloids, Vol. I., Interscience Publishers, New York (1957).
4. Chemistry of Organic Natural Products, Vol. I & II, O. P. Agrawal.
5. Organic Chemistry of Natural Products, Vol. I & II, Chatwal.
6. Organic Chemistry (5/e) by Morrison & Boyd.
7. Chemistry of Vitamins – S. F. Dyke.
8. Natural Products Chemistry, Vol. I & II, K. Nakanishi.
9. The Molecules of Nature, J. B. Hendrickson.
10. Selected Organic Synthesis: Ian Fleming.

11. Chemistry of Natural Products, N. R. Krishnaswamy.
12. The Chemistry of Natural Products, K. W. Bentley. Vol. I – V.
13. J.W. Apsimon, Total Synthesis of Natural Products, Vol. 1-6, Wiley-InterSciencePublications, New York (Vol. 1, 1973).
14. Principles of biochemistry –Donald J.Voet, Judish G.Voet, charlotte w. pratt (John willey and sons)
15. Lehninger principles of biochemistry- David L.Nelson and Michael M.wx (Palgrave Macmillan / w.h. freeman company new york)
16. Biochemistry – U.Satyanarayana Baro and allied P.Ltd., kolkata

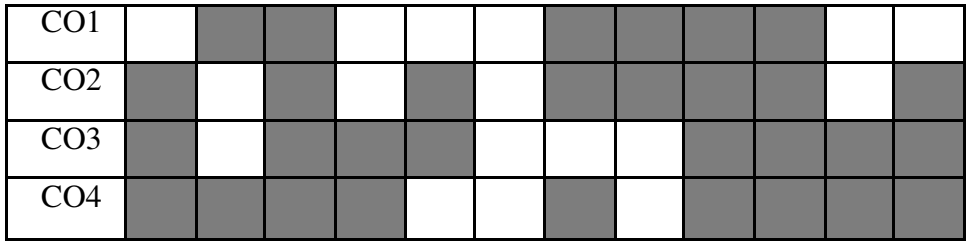
On-line resources to be used if available as reference material
On-line Resources

Master of Science, Organic Chemistry
M.Sc.Organic Chemistry, Semester III
PAPER-II

Course Code	[1903080203020003]	Title of the Course	**Selected Topics in Organic Chemistry-I**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand the familiarize with the basic properties, theory & interpretation of ^{1}H NMR, ^{13}C NMR and 2D NMR spectrometry, to impart knowledge in the theory & principals of spectroscopic techniques for characterization & differentiation of various molecules. • To learn about various pollution-water & air and effluent treatment. Contamination of water through heavy minerals, halogens, pathogens, air pollution, detection of various components and hydrocarbons, effluent treatment of sugar, peeper & pulp and distilleries. • To learn monocyclic, fused and bridged heterocyclic compounds, their nomenclature, synthesis, aromatic character, reactivity and application in the preparation of building blocks, fine chemicals and dye industry. • To understand the role of chemical reagents in oxidation, reduction, cyclisation and transformation of various organic functional groups, their synthesis and industrial application.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12

Course Content		
Unit	Description	Weightage* (%)
1.	**NMR SPECTROSCOPY** Theory and principles of NMR spectroscopy, Theory of Fourier Transform **(i) 1H NMR Spectroscopy** Proton resonance condition, Aspects of PMR spectra – number of signals, chemical shift, factors influencing chemical shift, deshielding, chemical shift values and correlation for protons bonded to carbons (aliphatic, olefinic, aldehydic, aromatic) and other nuclei (alcohols, phenols, enols, acids, amides and mercaptans), effect of deuteration, spin- spincoupling, (n+1) rule, factors effecting coupling constant "J" **(ii) 13C NMR spectroscopy** Types of 13C NMR Spectra: proton coupled and decoupled 13C spectra, chemical shift, calculations of chemical shifts of aliphatic, olefinic, alkyne, aromatic, hetero aromatic and carbonyl carbons, factors affecting chemical shifts **(iii) 2D NMR Techniques** Preliminary idea of 2D NMR ,	25
2.	**ENVIRONMENTAL CHEMISTRY** **(i) Water Pollution**: Basic Concepts of Eutrophication, Water Quality, Water contaminants, Heavy minerals, Organic contaminants, PCBs and other Halogens materials, PAH, Pesticides, Waterborne Pathogens, Aquatic toxicology, Water Purification Methods, Sewage treatment. **(ii) Air Pollution:** Air pollution sources and emissions- Particulates, Aerosols, Photochemical smog, Determination of SOx, NOx, COx and hydrocarbons, Air pollution control technologies of particulate and gaseous pollutants	25

	(iii) Effluent treatme nt: Industrial pollutio n of sugar, distille ry, drug, pulp & paper and their analysis. Effluent treatment plants of above industries.	
3.	**HETEROCYCLIC CHEMISTRY-I** (i) Nomenclature of Heterocycles: Hantzsch-Widman nomenclature systems formonocyclic andfused heterocycles and bridged heterocycles (ii) Five and six membered heterocycles with two hetero atoms: Synthesis, reactivity, aromatic character and importance of following heterocyclic rings: Oxazole, Thiazole, Pyrazole, Imidazole, Pyridazine, Pyrimidine, Pyrazine (iii) Condensed five membered heterocycles: Synthesis, reactivity, aromatic character and importance of following heterocyclic Rings: Benzoxazole, Benzthiazole, Benzopyrazole, Benzimidazole.	25
4.	**REAGE NTS FOR ORGANIC SYNTHE SIS** Introduc tion, Prepara tion and Industria l Applica tions of the following,(1)N-Bromosuccinimide (NBS) (2)Grubbs 1st and 2nd generation catalyst (3)N,N-d ic yc lohe xylc arbo diimide (DCC) (4)Lead tetra-acetate (LTA) (5)Baker's yeast (6)n- butyl lithium (7) K3Fe (CN)6 and DMSO (8) Grignard Reagent (9)Diazomethane (10)Polyphosphoric acid	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 the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%

3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand fundamental & basic terms involved in ^{1}H NMR, ^{13}C NMR & 2D NMR spectroscopy, know effects of various factors on the spectra, interpretation from spectral data, identify structure of organic compounds by using combined spectral data, distinguish isomers and other closely related compounds by using spectral techniques.
2.	Learn water & air pollution, basic concepts of Eutrophication, water contamination with heavy materials, halogens, hydrocarbons and water purifying techniques and purification of water, sewage treatment, determination of air pollutants SOX, NOX, COX and hydrocarbons. Development of technologies to compart gaseous pollutants, effluent treatment of various paper pulp & distillation.
3.	To understand the basic concept of name reaction for the heterocyclic chemistry, aware about all heterocyclic ring systems such as mono, bi,,tri and fused ring systems with all backgrounds in terms of naming of new compounds, application of heterocycles in medicinal chemistry.
4.	Understand the chemistry involved in oxidation, reduction, transformation, cyclisation etc by employing numerous reactants to appreciate the chemo-selectivity of the reagents, synthesis of reagents with respective mechanism and their application in industry. Suggest the use of miscellaneous reagents in organic synthesis.

Suggested References:

Reference Books Recommended:

1. R.M. Silverste in and F.X. Webster, Spectrosc opic Identifica tion of Organic Compoun ds, 6th Edition (2003) John Wiley, New York.
2. D.H. Willia ms and I.F. Fleming, Spectrosc opic Methods in Organic Chemistry, 4th Edition(1988), Tata-McGraw Hill, New Delhi.
3. P.Y Bruice, Organic Chemistry, 2nd Edition (1998) Prentice – Hall, New Delhi.
4. Nuclear Magnetic Resonance – Basic Principles- Atta-Ur-Rehman, Springer- Verlag (1986).
5. One and Two dimensional NMR Spectroscopy – Atta-Ur-Rehman, Elsevier (1989).
6. Organic structure Analysis- Phillip Crews, Rodriguez , Jaspars, Oxford Unive rsity Press (1998).
7. G.W. Vanloon, S.J. Duffer, Environme n ta l Chemistry - A Global Perspective, Oxford University Press (2000).
8. F.W. Fifield and W.P.J. Hairens, Environme n ta l Analytic a l Chemistry, 2nd Edition (2000),

Black Well Science Ltd.
9. Colin Baird, Environmental Chemistry, W.H. Freeman and Company, New York (1995).
10. A.K. De, Environmental Chemistry, 4th Edition (2000), New Age International Private Ltd., New Delhi.
11. Peter O. Warner, Analysis of Air Pollutants, 1st Edition (1996), John Wiley, New York.
12. S.M. Khopkar, Environmental Pollution Analysis, 1st Edition (1993), Wiley Estern Ltd., New Delhi.
13. S.K. Banerji, Environmental Chemistry, 1st Edition (1993), Prentice-Hall of India, New Delhi.
14. An introduction to the chemistry of heterocyclic compounds-R M Acheso
15. Heterocyclic Chemistry- J A Joule and Smith
16. Heterocyclic Chemistry-II- R R Gupta, M Kumar, V Gupta, Springer (India) pvt
17. Heterocyclic Chemistry, 4th Edition by J. A. Joule & K. Mills, Published by Chapman & Hall (1995)
18. Principles of modern heterocyclic chemistry, Edited by Leo A. Paquette, Published by Pearson Benjamin Cummings (1968)
19. Heterocyclic Chemistry, 3rd Edition by Thomas L. Gilchrist, Published by Prentice Hall (1997)
20. The Structure & Reactions of Heterocyclic Compounds, Edited by Michael Henry Palmer, Published by Edward Arnold (1967)
21. Heterocyclic chemistry by V. K. Ahluwalia, Narosa publishing house.
22. Organic synthesis using transition metals-Roderick Bates (Wiley).
23. Organic chemistry – J. Clayden, N. Greeves, S. Warrenand P. Wothers (Oxford Press).
24. Advanced organic chemistry, Part B – F. A Careyand R. J. Sundberg, 5th edition (2007).
25. Guidebook to organic synthesis-R K Meckie, D M Smith and R A Atken.

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

Master of Science, Organic Chemistry
M.Sc.Organic Chemistry, Semester III
PAPER-III

Course Code	[1903080203030003]	Title of the Course	**Organic Chemistry in Industry**
Total Credits of the Course	4	Hours per Week	4 hrs

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.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												
CO4												

Course Content		
Unit	Description	Weightage* (%)
1.	**ORGANIC CHEMISTRY IN INDUSTRY** Introduction, Process Chemistry versus Research Chemistry Pharmaceutical Industry: Drug Discovery, Drug development, Preclinical and clinical testing, Medicine, Future Problems and Opportunities Agrochemical Industry: Classification, Biodegradable and Persistent Pesticides, Toxicity, Chemical Classification of Pesticides-Herbicides and Insecticides	25
2.	**BASIC CONCEPTS OF DYE AND DYE INTERMEDIATES** Introduction of Dyes and Pigments, Absorption of visible light, colour of wavelength absorbed, complementary colour. Relation betweencolor andchemical Constitution, Witt's theory, Armstrong's theory, Nietzki's theory, Valence bond theory, Molecular orbital theory, Fastness Properties, Exhaustion and fixation properties. Natural Dyes, Nomenclature of Dye Intermediates, Colour Index	25

	Classification of Dyes: Based on structure, based on mode of application to fibres, Non– Textile uses of dyes: Dyes in medicine, leather, paper, colour photography and electro photography, food, cosmetics, displays and laser dyes.	
3.	**BASIC CONCEPT OF DRUGS** Introduction, Classifications: Onthe basis of their chemical structure andtherapeutic action, Nomenclature: Proprietaryand Non-proprietary name, Nomenclature of new drugs by WHO, Names of drugs: Generic and brand names Theories of drug action: Occupancytheory, Rate theory andinduced fit theory Biological defence, chemical defences, Furguson principle Absorption of drugs: Routes of administration, factors that affect on absorption Physic o chemica l prope rties: Solubility, Partition coefficie nts, Ioniza tion constant,Electronic effect, Steric effect, Stereochemical consideration	25
4.	**UNIT PROCESSES** (i) Nitration:N itra tin g agents. Mechanism of aromatic nitratio n. Industria l chemica ls derived from Benzene, Naphthalene, Anthracene using Nitration. (ii) Sulphonation and Sulfation: Sulphonating and Sulfating agents. Mechanism of aromatic Sulphonation. Industrial chemicals derived from Benzene, Naphthalene, Anthracene using Sulphonation. (iii) Amina tion: Amina ting agents, Amina tion by reduction, Amina tion by Ammono lysis. Industrial chemicals derived from Benzene using Amination. (iv) Alkyla tion: Alkyla ting agents. Industria l importa nt alkyl compounds derived by various routs **(v) Halog enation:** Ha loge na ting agents. Industria l importa nt halogenated compounds derived by various routs	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 the Evaluation	Weightage

1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	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:

Reference Books Recommended

1. Organic Chemistry: A Mechanism Approac h; Penny Chalone r, CRC Press, Tailor and Francis; Florida.
2. Pharmace utic a l Process developme nt: Curre nt Chemica l and Enginee ring Challe nge s, J. Blacker and M. T. Williams, RSC Cambridge, UK.
3. Fine Chemicals: The Industry and Its Business, P. Pollak, 2nd Edition, Wiley.
4. The chemistry of synthetic Dyes, Vol. I to VII by Venkataraman, Academic Press, New York.
5. Chemistry of Synthetic Dyes & Pigments by Lubs.
6. Dyes and their intermediates by E. N. Abrahart.
7. Handbook of synthetic dyes and pigments, Vol. I & II by K. M. Shah.
8. Industrial Dyes by Klans Hunger, Germany by Wiley-VCH.
9. Development in the Chemistry andtechnology of Organic Dyes by J.Griffiths, Blackwell Sci. Pub., Oxford, London.
10. Principles of colour Technology by Fred W. Billmeyer and Max Saltzman, John Wiley & Sons.
11. Medicinal Chemistry by G. R. Chatwal.
12. A textbook of Pharmaceutical Chemistry by Jayshree Ghosh.
13. Chemical Process Industries by R. N. Shreve.

14. Riegel's Hand-Book of Industrial Chemistry, Ed. by James A. Kent.
15. Industrial Chemicals by Faith, Keyes, Clark.

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

Master of Science, Organic Chemistry
M.Sc.Organic Chemistry, Semester III
PAPER-IV

Course Code	[1903080203040003]	Title of the Course	**Medicinal Chemistry-I**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand drug design. Different parameters for drug design, concept of drug design & optimization, SAR, receptor, administration, role of enzymes in biotransformation and relevant parameters. • To understand types of psychoactive drugs, their division, classification, general structure, effect of substituent, their SAR, MOA and synthesis. • To learn about diuretics, hypoglycemic and cardiovascular agents/drugs. Classification, general structure, effect of substituent, their SAR, MOA and synthesis. • To understand Analgesic, antipyretic, NSAIDs Agents, classification, general structure, effect of substituent, their SAR, MOA and synthesis.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content		
Unit	Description	Weightage * (%)
1.	**DRUG DESIGN, PHARMACOKINETICS AND PHARMACODYNAMICS** Drugs and Drug Design Introduction, drug targets, procedure for drug design, pro- drug,concepts of lead compounds, lead modification, structure activity relationship (SAR), LD50, ED50, therapeutic index, Concepts of drug receptors, Elementary treatment of drug receptor interactions. Introduction to Phramcokinetic and Pharmacodynamic, Drug administration, Drug absorption, drug distribution, drug metabolism (general pathway of drug metabolism: Phase-I and Phase-II), elementary treatment of enzyme stimulation, biotransformation, Drug excretion.	25
2.	**PSYCHOACTIVE DRUGS** (i) General anaesthetics: General classification and Structural variations (ii) Local Anaesthetics: General classification and SAR (iii) Sedatives and Hypnotics: General classification, Structural variations and mode of action Synthesis and therapeutic uses of only the following: Thiopental (Pentothal), Amobarbital (Amytal), Diazepam, Chlorazepam, alprazolam, glutethimide, Nikethamide, Benzocaine, Procaine, Lidocaine (xylocaine), Dibucaine (Nupercaine), Phenacaine (Holocaine).	25
3.	**Antipyretic Analgesics and NSAIDs Agents** General classification of Antipyretic Analgesics, Narcotic Analgesics and Non-Steroidal Anti- Inflammatory Drugs Structural variations in Morphine , Morphan and 4-Phenylpiperidine Analogues. Opioid Receptors (Name only), Limitations of Opoids, Synthesis and therapeutic uses of only the following: Meperidine (Pethidine), Ibuprofen, Meclofenamate sodium, Oxyphenbutazone, Diclofenac Sodium, Mefanamic acid,	25
4.	**DIURETICS, ANTI-DIABETIC AGENTS AND CARDIOVASCULAR DRUGS** (i) Diuretics:	25

	General classification. Structural variation and SAR of Thiazide Diuretics Synthesis and therapeutic uses of only the following: Chlorothiazide, Furosemide, Ethacrynic acid, Triamterene (ii) Insulin and Oral Hypoglycemic Agents (Anti-diabetic agents or drugs affecting sugar metabolism): General classification, Synthesis and therapeutic uses of only the following: Glipizide, Glybomuride Troglitazone, Chlorporpamide, Glibenclamide (iii) Cardiovascular Drugs: General introduction of Antiarrythmic agents and Antihypertensive drugs Structure variation in ß-adrenergic blockers and Dihydropyridines, Structure – activity Relationship of ACE Inhibitors Synthesis andtherapeutic uses of only the following: Verapamil, Methyldopa, Atenolol, Lisinopril, Losartan	

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 the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand drug design, procedure of drug design, preparation of library of compounds-leads to identification and optimization. Various concept like pro drug, soft drug, SAR, MOA, ADMET and receptor, drug administration, pharmacokinetics and pharmacodynamics, role of enzyme in biotransformation etc.

2.	Learn general classification of psychoactive agents, difference between sedative and hypnotics, general structure of each class of drugs with substituent, their SAR and trivial/generic name, synthesis and uses of selective drug.
3.	Understand general classification of analgesic, antipyretic, NSAIDs Agents, general structure of each class of drugs with substituent, their SAR and trivial/generic name, synthesis and uses of selective drug.
4.	General classification of diuretics, general structure of each class of drugs with substituent, their SAR and trivial/generic name, synthesis and uses of selective drug method..

Suggested References:

Reference Books Recommended

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., New York).
2. Principles of Medicinal Chemistry, Vol. I & II (5/e), byS. S. Kadam, K. R. Mahadik, K. G. Bothra (Nirali Prakashan).
3. Principles of Medicinal Chemistry by William O. Foye (ed.), Lea and Febiyer, Philadelphia.
4. Wilson and Gisvold's Text-book of Organic Medicinal and Pharmaceutical Chemistry (5/e, 1982) by Robert F. Doerge (J. B. Lippinc ott Compa ny, Philade lphia /T oppa n Co. Ltd., Tokyo).
5. Essential of Medicinal Chemistry (2/e) by Andrejus Korolkovas (A Wiley Interscience Publication, 1988, John Wiley & Sons, Canada).
6. Medicinal Chemistry by Ashutoshkar (Wiley Eastern Ltd., 1993).
7. The Pharmace utica l Basis of Therapeutics by Goodma n and Gilma n (The Macmilla n Co.).
8. The Organic Chemistry of Drug Synthesis, Vol. I,II & III (1980), Ed. By D. Lednicer and L.A.Mitscher (John Wiley and Sons, New York).
9. Topics in Medicinal Chemistry, Vol. I & II by Rabinowitz and Myerson (Editor) (Interscience, 1968).
10. Adhunik Sanshleshit Aushodhonu Rasayanvig hya n, Dr. Anamik Shah, Unive rsity Granth Nirman Board, Ahmedabad.
11. Medicinal Chemistry, D. Sriram and P. Yogeeswari, 1st edi., Pearson Education, 2007.
12. Handbook of pharmaceutical chemicals by Dr. A. R. Shenoyand Dr. V. R.Shenoy Multitech Publishing Co., 15-Yogesh, Hingwala Lane, Ghatkopar (East) Mumbai.
13. Fundamentals of Medicinal Chemistry by G Thomas.

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

On-line Resources

Master of Science, Organic Chemistry
M.Sc.Organic Chemistry, Practicals
Semester- III

Course Code	[1903080203050001]	Title of the Course	
Total Credits of the Course	4	Hours per Week	4 hrs

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. • Preparation of reagent to carry out estimation. • To understand the purpose of estimation and establishment of respective condition.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■
CO5	■	■	■	■			■		■	■	■	■
CO6	■	■	■	■			■		■	■	■	■

Course Content

1	Green Synthesis	4- Credit
2	Preparation (From Given Name reactions)	
3	Estimation	4- Credit
4	Viva-Voce	

Green Synthesis (Anyfour)

1. Preparation of acetanilide from aniline and acetic acidusing Zn dust.
2. Base catalyzed aldol condensation using LiOH.H2O as a Catalyst.
3. Bromination of *trans*-stilbene using sodium bromide andsodium bromated.
4. [4+2] cycloaddition reaction in aqueous medium at room temperature.
5. Benzil Benzilic acid rearrangement under solvent free condition

Preparation of industrially important compounds by following Name reactions (Any four)

1. Sandmayer reaction
   (P-chloro toluene from p-toluidine)
2. Fischer indole synthesis
   (1, 2, 3, 4-tetra hydroc a rbaz ole from cyclohe xa none and phenylhydraz ine)
3. Riemer-Tiemann reaction (Salicyladehyde from phenol)
4. Skraup synthesis (Quinoline from aniline)
5. Gebriel phthalimide synthesis
   (Anthra nilic acid from phtha lic anhydride and phtha limide)
6. 2-hydroxy 1-naphthaldehyde from β naphthol

Organic Estimations (Any Six)

1. Determination of Sulphonamides with Silver Nitrate solution by Volumetrically.
2. Determination of aromatic primary amines by either diazotization or indirect diazotization.
3. Estimation of Benzyl Penicillin.
4. Determina tion of coupling value (C.V.) of Dye interme dia tes.
5. Non-aqueous titration of Sodium Benzoate.
6. Estima tion of Isonazid.
7. Enzyme inhibition
8. -NO_2 and-OH group

Teaching-Learning Methodology	Introduction, interaction with students in calculation of mole ratios, carrying out experiments at each step according to the respective practical.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	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 ratio.
2.	Establish mechanism of reaction and monitoring specified reaction condition.
3.	Learn to work-up after the completion of reaction, purification.
4.	Confirm the product through the references.
6.	Learn to set up reaction condition for individual estimation of compound.
7.	Understand the calculation with reference to respective factors.
8.	Appreciate good laboratory practices.

Suggested References:

Reference Books Recommended

5. Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Ren Aggarwal
6. Monograph on Green Chemistry Laboratory Experiments by Green Chemistry Task Force Committee, DST
7. Quantitative analysis by Arther I.Vogel
8. Quantitative analysis by V.K.Ahluwalia
5. Quantitative analysis by Mann and sanders

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	Advance Organic Chemistry	4	1	4
2	Selected Topics In Organic Chemistry-II	4	1	4
3	Advance Organic Synthesis	4	1	4
4	Medicinal Chemistry-II OR	4	1	4

	Dye and Intermediates-II			
5	Practicals	12		8
		28	4	24

External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No	Course group	Credit	Internal Marks	External Marks	Total Marks
M. Sc.	IV	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	08	60	140	200
			Total	24	180	420	600

Master of Science, Organic Chemistry
M.Sc.Organic Chemistry, Semester IV
Paper 1

Course Code	[2003080204010003]	Title of the Course	**Advance Organic Chemistry)**
Total Credits of the Course	4	Hours per Week	4 hrs

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. • Role 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.

Mapping between CO and PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content

Unit	Description	Weightage* (%)
1.	**NAME REACTIONS** General nature, method, mechanism andsynthetic applications of the following reactions; (1)Ugi reaction (2)Noyori reaction (3)Wittig reaction (4)Petersonolefination reaction (5)Mannich reaction (6)Stille reaction (7)Ene recation (8)Staudinger reaction (9)Corey-Fuchs reaction (10)Ritter reaction (11)Mcmurry reaction (12)Michael addition	25
2.	**OXIDATION** Introduction, Oxidation with Cr(VI), Mn(VII), Mn(IV), OsO_4, Periodic acid. Peroxy acid. Oxidation of hydrocarbons-alkenes, aromatic rings, saturated C-H group (activated and unactivated), aldehyde and ketones	25
3.	**REDUCTION**	25

	Introduction, different reductive processes, hydrocarbons-alkenes, alkynes and aromatic rings, Carbonyl compounds- aldehydes, ketones, ($LiAlH_4$, $NaBH_4$ only for aldehyde and ketone) acids and their derivatives, epoxides, nitro, nitroso, azo and oxime groups, Birch reduction, Shapiro reduction.	
4.	**MOLECULAR REARRANGEMENTS** Rearrangement involving migration toelectron deficient carbon: (i) Expansion and contraction of rings/Demajnov rearrangement (ii) Benzil-benzilic acid rearrangement Rearrangement involving migration to electron rich carbon: (i) Favorskii rearrangement (ii) Sommelet-Hauser rearrangement (iii) Neber rearrangement Rearrangement involving migration to electron deficient nitrogen: (i) Schmidt rearrangement (ii) Curtius rearrangement Aromatic rearrangements: (i) Migration around the aromatic nucleus: Jacobsen rearrangement (ii)Migration of group from the side chain to the nucleus: Orton rearrangement, Hoffmann-Martius rearrangement, Rearrangement ofN-nitrosoanilines (Fischer- Hepp rearrangement). Rearrangement involving migration from oxygen to ring: (i) Fries rearrangement (ii) Claisen rearrangement	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 the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learnerwill 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:

Reference Books Recommended:

1. Organic synthesis using transition metals-Roderick Bates (Wiley)
2. Organic chemistry – J. Clayden, N. Greeves, S. Warrenand P. Wothers (Oxford Press)
3. Some modern methods of organic synthesis – W. Carruthers (Cambridge)
4. Organic synthesis – Michael B. Smith
5. Advanced organic chemistry, Part B – F. A Careyand R. J. Sundberg, 5th edition (2007)
6. Guidebook to organic synthesis-R K Meckie, D M Smith and R A Atken
7. Organic synthesis- Robert E Ireland
8. Strategic Applications of named reactions in organic synthesis-Laszlo Kurti and Barbara Czako
9. Organic Synthesis, Jagdamba Singh & L.D.S. Yadav, 6th edition, Pragati Prakashan (2010).
10. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976)
11. Advance Organic Chemistry, Reaction Mechanism and Structure by Jerry March, 4th ed. John Wiley & Sons, 1992

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

Master of Science, Organic Chemistry
M.Sc.Organic Chemistry, Semester IV
Paper I1

Course Code	[2003080204020003]	Title of the Course	**Selected Topics in Organic Chemistry-II**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand and familiarize the basic principles, theory and instrumentation of mass spectroscopy, low and high resolution mass spectra, to impart knowledge in theory and principles of spectroscopy, spectroscopic technique for characterization and differentiation of various nucleus. • To understand kinetically and thermodynamically controlled reactions, effect of substituent on structure on reactivity, terms involved in linear free energy relationship. • To provide basic theoretical understanding of heterocyclic chemistry, improving general methodology for different kind of ring synthesis which implies the new heterocyclic systems by changing the functionality with respective positions in skeleton. • To understand natural and synthetic polymers, structural variations, classification properties and applications.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content		
Unit	Description	Weightage* (%)
1.	**MASS SPECTROMETRY**	25

	Theory and principles of mass spectroscopy; Instrumentation; low and high resolution mass spectra; Ionization techniques – Electron Impact (EI) ionization, Chemical Ionization (CI), Field Desorption (FD), Fast Atom Bombardment (FAB), Electronspray Ionization (ESI); Determination of molecular weight and molecular formula, nitrogen rule, detection of molecular ion peak, metastable ion peak; Fragmentations – rules governing the fragmentations, McLaffertyrearrangement; Interpretation of mass spectra of different class of compounds – saturated and unsaturated hydrocarbons, aromatic hydrocarbons, alcohols, ethers, ketones, aldehydes, carboxylic acids, amines, amides, compounds containing halogens; To write possible fragmentation for given compound; To identify structure from mass spectral data; To identify structure from combined spectral data. *Structure elucidation by suing UV, IR, NMR and Mass Spectroscopic techniques*	
2.	**STRUCTURE-REACTIVITY PRINCIPLES** Types of mechanisms, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammonds postulate, Curtian-Hammet principle , potential energy diagrams, transition state and intermediates, methods of determining mechanisms-isotope effect. Effect of structure on reactivity- resonance and field effect, steric effect, quantitative treatment. The Hammet equation and linear free energy relationships, substituent and reaction constants, positive and negative deviation from Hammet equation, Taft equation,Solvent effect	25
3.	**HETEROCYCLIC CHEMISTRY-II** (A) Five andsix membered heterocycles with more thantwo hetero atoms: Synthesis, reactivity, aromatic character and importance of following heterocycles:1,2,3- triazole, 1,2,4-triazole, 1,2,4-oxadiazole, 1,3,4-oxadiazole, 1,2,5-oxadiazole (B) Condensed six membered heterocycles: Synthesis, reactivity, aromatic character and importance of following heterocyclic Rings: Quinoline , Isoquinoline , Cinnoline, Quinoxaline , Phthalazine, Naphthyridine , Phenoxazine	25
4.	**SYNTHETIC AND BIO-POLYMERS** **Bio-polymers**: General introduction, types, properties and uses of polysaccharides – starch and cellulose	25

	Synthetic polymers: General introduc tion, method of prepara tion, propertie s and uses of Polyester, poly-tetrafluoroethylene, polyamino acids, polycyanoacrylates, polyurethanes, silicone rubbers, polyphosphazenes, divinylether -maleic anhydride cyclopolymer (DIVEMA) polymeric antioxidants	

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 the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Understand the theory, instrumentation and important terms of mass spectrometry, fragmentation pattern, to set valuable insight into the types of molecular interaction and interpreting from obtained data.
2.	To learn about basic concept, synthesis and application of heterocyclic chemistry, aware about heterocyclic systems, types of heterocyclic rings, application of heterocycles in medicinal chemistry.
3.	To learn about type of reactions in context to kinetically and thermodynamically control concept, derivatization of various equation and their significance, different terminology and their application in designing various bioactive scaffolds.
4.	To learn about natural and synthetic polymers, their classification, properties and synthetic applications.
Suggested References:	

Reference Books Recommended:

1. Spectrosc op ic Identifica tion of Organic Compou nds, R. M. Silverste in and F. X. Webster, 6th edition (John Wiley & Sons)
2. Introduc tion to Spectrosc opy, D. L. Pavia, G. M. Lampma n and G. S. Kriz, 3rdedition

(Thomson Brooks/Cole)
3. Spectrosc op ic Methods in Organic Chemistry, D. H. Willia ms and I. Fleming, 4thedition (Mcgraw – Hill Book Company)
4. Organic Spectroscopy, William Kemp, 3rd edition (Palgrave)
5. Organic Spectrosc opy – Principles and Applica tions, Jag Moha n, 2nd edition (Narosa Publishing House)
6. Spectroscopy of Organic Compounds, P. S. Kalsi, 5thedition (New Age International Publishers)
7. Elementary Organic Spectrosc opy: Principle s and Chemica l applic atio ns (revise d edition), Y. R. Sharma (S. Chand Publishing)
8. Organic Chemistry by Francis A. Carey (McGraw-Hill Book Co., 1987).
9 .Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell Uni.Press.
10. Principle s of Organic Synthe sis, R.O.C. Norma n and J. M. Coxon, Blackie Academic and Professional.
11 .Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillan.
12. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers
13. An introduction to the chemistry of heterocyclic compounds-R M Acheso
14. Heterocyclic Chemistry- J A Joule and Smith
15. Heterocyclic Chemistry-II- R R Gupta, M Kumar, V Gupta, Springer (India) pvt
16. Heteroc yc lic Chemistry, 4th Edition by J. A. Joule & K. Mills, Publishe d by Chapma n & Hall (1995)
17. Principles of modern heterocyclic chemistry, Edited by Leo A. Paquette, Published by Pearson Benjamin Cummings (1968)
18. Heterocyclic Chemistry, 3rd Edition by Thomas L.Gilchrist, Published by Prentice Hall (1997)
19. The Structure & Reactions of Heterocyclic Compounds, Edited by Michael Henry Palmer, Published by Edward Arnold (1967)
20. Heterocyclic chemistry by V. K. Ahluwalia, Narosa publishing house.
21. Harry R. Allcoc k, Frederic k W. Lampe and James E. Mark, Conte mpora ry Polymer Chemistry, 3rd edition, Pearson Prentice Hall, 2005.
22. Organic Polymer Chemistry by K. J. Saunders.

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

Master of Science, Organic Chemistry
M.Sc.Organic Chemistry, Semester IV
Paper 1II

Course Code	[2003080204030003]	Title of the Course	Advance Organic Synthesis

Total Credits of the Course	4	Hours per Week	4 hrs

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.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content		
Unit	Description	Weightage* (%)
1.	**PROTECTING GROUPS** Need of protecting groups – Protection of alcohols, Carbonyl, Carboxylic acid and amino groups, Synthetic equivalent groups and examples on transformations	25
2.	**DISCONNECTION APPROACH** Introduction to disconnection, Concept of synthon, Synthetic equivalent, Functional group interconversion	25

	(i) One group disconnection: Disconnection and synthesis of alcohols, olefins, simple ketones, acids and its derivatives (ii) Two groups disconnection: Disconnections in 1,3-dioxygenated skeletons, preparation of β-hydroxy carbonyl compounds, α,β-unsaturated carbonyl compounds,1,3-dicarbonyls, 1,5- dicarbonyls and use of Mannich reaction (iii) Pericyclic reactions: Disconnections based on Diels-Alder reaction and electrocyclic reaction: Its use in organic synthesis	
3.	**RING SYNTHESIS** Introduction to ring synthesis (i) Synthesis of saturated heterocycles: Synthesis of 3 and 4 membered rings (ii)heterocycles in organic synthesis: Synthesis of alkanes and cycloalkanes from thiophene, Synthesis of alkenes and cycloalkenes from pyridines, Synthesis of Aromatic compounds from pyrilium salts, pyridazine, thiophenes and furan	25
4.	**ORGANOMETALLIC COMPOUNDS AND THEIR APPLICATIONS** (i) Carbon-metal bonds in organometallic compounds, Synthesis and applications of Organolithium, Organozinc and Lithium diorganocuprate. (ii) Basic concept of organoboranes, Preparation of organoboranes, Stereochemistry of hydroboration, Mechanism of hydroboration – oxidation, Synthetic applications.	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 the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	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:

Reference Books Recommended:

1. Organic synthesis using transition metals-Roderick Bates (Wiley).
2. Organic chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press).
3. Some modern methods of organic synthesis – W. Carruthers (Cambridge)
4. Organic synthesis – Michael B. Smith.
5. Advanced organic chemistry, Part B – F. A Careyand R. J. Sundberg, 5th edition (2007).
6. Guidebook to organic synthesis-R K Meckie, D M Smith and R A Atken.
7. Organic synthesis- Robert E Ireland.
8. Strategic Applications of named reactions in organic synthesis-Laszlo Kurti and Barbara Czako.
9. Organic Synthesis, Jagdamba Singh & L.D.S. Yadav, 6th edition, Pragati Prakashan (2010).
10. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
11. Advance Organic Chemistry, Reaction Mechanism and Structure by Jerry March, 4th ed.
    John Wiley & Sons, 1992.
12. Designing Organic Synthesis – A Programmed Introduction to the Synthon Approach, Stuart Warren, John Wiley & Sons (1994).
13. Organic Synthesis: The disconnection approach, Stuart Warren, John Wiley & Sons (1994).
14. Selected Organic Synthesis, Ian Fleming, John Wiley & Sons (1977).
15. Principles of Organic Chemistry by R.O.C. Norman (Chapman and Hall, 1986).
16. Organometallic Chemistry by P. L. Pauson (Edward Arnold, 1968).

17. Principles of Organometallic Chemistry by Coats, Green, Powell & Wade (Chapmanand Hall, 1977).

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

Master of Science, Organic Chemistry
M.Sc.Organic Chemistry, Semester IV
Paper IV

Course Code	[2003080204040003]	Title of the Course	**Medicinal Chemistry-II**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand antibiotics, classification and drug belong to that class, structural variation, synthesis and uses of antibiotics. • To learn about types of anti allergic and anti infective drugs, their classification, general structures, effect of substituent, SAR, synthesis and uses. • To understand anti malarial 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 anti viral and anti-HIV agents, structural variation, synthesis and uses.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1		■	■				■	■	■	■		
CO2	■		■		■		■	■	■	■		■
CO3	■		■	■	■				■	■	■	■
CO4	■	■	■	■			■		■	■	■	■

Course Content		
Unit	Description	Weightage*

		(%)
1.	**ANTIBIOTIC S** General introduction and classification of antibiotics Broad spectrum antibio tics, Macrolide antibiotic s, Amino glycoside antibiotics and Non-classifiable antibiotics (i) β-lactam antibiotics: Penicillins (Structural variations and SAR), Cephalosporins (Structural variations) (ii) Non-lactam antibiotics: Tetracyclin (Structural variations and SAR) Structures andmedicinal importance/ clinical uses/pharmacological applications of the following: Bacitrac in, Vancomyc in, Erythromyc in, Lincomyc in, Chlora mphe nic ol, Nalidixic acid, Norfloxacin, Ciprofloxacin Synthesis and therapeutic uses of only the following: Methicillin, Ampicillin, Cephalexin, Chloramphenicol, Ciprofloxacin	25
2.	**ANTIALLERGIC AND LOCAL ANTI INFECTIVE DRUGS** **(A) Antihistamines and related Antiallergic Drugs:** General introduction andmode of action, Structure variation in Aminoalkylethers, Ethylenediamines and Piperazine derivatives. Synthesis and therapeutic uses of only the following: Diphenhydramine (Benadryl), Antazoline, Chlorpheniramine, Primethazine **(B) Anti –mycobacterial agents:** General Introduc tion of Tuberculosis & Leprosy -disea se , Treatme nt, Mode of action, adverse effect of Anti TB agents & Anti–leprotic agents Synthesis and therape utic uses of only the followin g: Ethiona mide, Ethambutol, DDS (Dapsone), Pyrazinamide. **(C) Sulfonam ides:** General classification, mode of action and SAR Synthesis and therapeutic uses of only the following: Sulfame tho xine (Sufadoxine), Sulfameth oxy -Pyraz ine (Sulfa le ne), Succinyl sulfathiazole (Sulfasuxidine)	25
3.	**Antimalerials and Antineoplastic agents**	25

	(A) Antimalarials: Introduc tion, Types, Life cycle of plasmodium, drug resistance, General classific atio n, SAR of 4- and 8-aminoquinolines and Structure variation in Sesquiterpene Lactones, mode of action Synthesis and therapeutic uses of only the following: Mefloquine, Chloroquine, Primaquine, Pyrimethamine (Daraprim), Quinacrine **(B) Antineoplastic Agents (Cancer Chemotherapy):** Introduction to cancer, types, Causes & Treatment of cancer, Metastasis, Drug Resistance, Targets of anticancer agents, adverse effects of cancer therapy(in brief) General classification of antineoplastic agents, Cell Cycle-Specific (CCS) and Non Cell Cycle-Specific (CCS) Agents, Mode of action, Synthesis and therapeutic uses of only the following: Mechloretha mine , Cyclop hosp ha mide , Melpha la n, 6-Mercapto pyrine,T rime tre xa te, Cytarabine	
4.	**Anti-Viral and Anti-HIV agents** **(A) Antiviral agents**: Introduction, Types & classes of viruses, Classification of antiviral agents, mechanism of action, Antiviral Compounds for DNA Viruses & Selected RNA Virus Infections other than HIV (Influenza A and B Viruses, Hepatitis C Virus) **(B) Anti-HIV Drugs:** Introduction, HIV Infection andits Pathological Effects, HIV Structure andlife cycle, Targets for Drug Design of Anti-HIV Agents, HIV drugs inclinical use,Development of Drug Resistance, the need for new Anti-HIV Drugs, Introduction of AIDS Synthesis andtherapeutic uses of only the following: Amantadine, Acyclovir, Zidovudine, Indinavir, Ritonavir	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, assignment etc.

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	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:

Reference Books Recommended

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., New York).
2. Principles of Medicinal Chemistry, Vol. I & II (5/e), by S. S. Kadam, K. R. Mahadik, K. G. Bothra (Nirali Prakashan).
3. Principles of Medicinal Chemistry by William O. Foye (ed.), Lea and Febiyer, Philadelphia.
4. Wilson and Gisvold's Text-book of Organic Medic ina l and Pharmace utica l Chemistry (5/e, 1982) by Robert F. Doerge (J.B. Lippincott Company, Philadelphia/Toppan Co. Ltd., Tokyo).
5. Essential of Medicinal Chemistry (2/e) by Andrejus Korolkovas (A Wiley Interscience Publication, 1988, John Wiley & Sons, Canada).
6. Medicinal Chemistry by Ashutoshkar (Wiley Eastern Ltd., 1993).
7. The PharmaceuticalBasis of Therapeutics by Goodman and Gilman (The Macmillan Co.).
8. The Organic Chemistry of Drug Synthesis, Vol. I,II & III (1980), Ed. By D. Lednicer and L.A. Mitscher (John Wiley and Sons, New York).
9. Topics in Medicinal Chemistry, Vol. I & II by Rabinowitz and Myerson (Editor)

(Interscience, 1968).
10. Adhunik Sanshleshit Aushodhonu Rasayanvig hya n, Dr. Anamik Shah, Unive rsity Granth Nirman Board, Ahmedabad.
11. Medicinal Chemistry, D. Sriram and P. Yogeeswari, 1st edi, Pearson Education, 2007.
12. Handbook of pharmaceutical chemicals by Dr. A. R. Shenoyand Dr. V. R.Shenoy Multitech Publishing Co., 15-Yogesh, Hingwala Lane, Ghatkopar (East) Mumbai.
13. Fundamentals of Medicinal Chemistry by G Thomas.

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

Master of Science, Organic Chemistry
M.Sc.Organic Chemistry, Practicals
Semester - IV

Course Code	[2003080204050001]	Title of the Course	
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• Able to interpret structure of organic compounds from spectra like UV, IR, NMR and Mass. • 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.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												

	CO2 ■ □ ■ □ ■ □ ■ ■ ■ ■ □ ■ CO3 ■ □ ■ ■ ■ □ □ □ ■ ■ ■ ■ CO4 ■ ■ ■ ■ □ □ ■ □ ■ ■ ■ ■ CO5 ■ ■ ■ ■ □ □ ■ □ ■ ■ ■ ■ CO6 ■ ■ ■ ■ □ □ ■ □ ■ ■ ■ ■

Course Content

1	Spectral Exercise	4- Credit
2	Preparation or organic compounds	
3	Green Synthesis	4- Credit
4	Viva-Voce	

1Spectral Exercise (Minimum 10 from syllabus)
Structure interpretation of organic compounds from spectra (UV, IR, NMR and Mass)

2 Preparation of industrially important compounds (Minimum 8)
1. Sulfanilamide from via p-acetamido benzene sulphonyl chloride and acetamido benzene-sulfonamide.
2. Acridone from anthranilic acid via o-chloro benzoic acid and N-phenylanthranilic acid
3. Benzocaine from p-nitro toluene via p-nitro benzoic acid and p-amino benzoic acid.
4. Eosin from phthalic acid via phthalic anhydride and fluorescein.
5. Benzanilide from benzene via Benzophenone and Benzophenonoxime.
6. p-Nitro chloro benzene from acetanilide via p-nitro acetanilide and p-nitroaniline.
7. p-Chloro bromo benzene from acetanilide via p-bromo acetanilide and p-bromoaniline.
8. Anthrone from phthalic anhydride via o-benzoyl benzoic acid and anthraquinone.
9. 4-Methyl-7-hydroxy-8-acetyl coumarin from resorcinol via 4-methyl-7-hydroxycoumarin and 4-methyl-7-acetyl coumarin.
10. Preparation of Congo red dye from naphthionic acid via hydrozobenzene.
11. Preparation of o & p-hydroxyacetophenone from Aniline via phenol and phenylacetate.

3. Green Synthesis (Any Four)
1. Green approach for preparation of benzopinacolone from bezopinacol using iodine catalyst
2. Preparation of 1, 1-bis-2-naphthol under grinding at room temperature

3. Three component coupling reaction by green approach.(Synthesis of dihydropyrimidinone)
4. Green approach to Transesterification reaction (Synthesis of biodiesel)
5. Ecofriendly nitration of phenols and its derivatives using Calcium nitrate

Teaching-Learning Methodology	Introduction, interaction with students in calculation of mole ratios, carry out experiments at each step according to the respective practical, interpretation of spectra and deduce the structure.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
3.	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 ratio.
2.	Establish mechanism and monitoring reaction at specified reaction condition.
3.	Learn to work-up after the completion of reaction, purification.
4.	Confirmation of product through the references.
6.	Learn to interpret structure of organic compounds from given spectra.
7.	Understand the calculation with reference to respective factors.
8.	Appreciate good laboratory practices.

Suggested References:

Reference Books Recommended:

1. Vogel's Textbook of practical organic chemistry, 5th edition, B. S. Furniss, A. J. , P. W. G. Smith, A. R. Tatchell (Pearson Education).
2. Comprehensive practical organic chemistry: Preparation and Quantitative analysis, V. K. Ahluwalia, Renu Agarwal (Universities Press).
3. Monograph on Green Chemistry Laboratory Experiments by Green Chemistry Task Force Committee, DST

4. L. D. Field, S. Sternhell, J. R. Kalman - Organic Structures from Spectra-Wiley (2013)

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

M.Sc. Semester-III (PHYSICAL CHEMISTRY)

Sr. No.	Course Title	L	T/C/S	Credit
1	Advanced Thermodynamics	4	1	4
2	Molecular Spectroscopy	4	1	4
3	Electro Analytical Techniques	4	1	4
4	Physical Chemistry of Materials	4	1	4
5	Practicals	12		8
		28	4	24

External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No	Course group	Credit	Internal Marks	External Marks	Total Marks
M. Sc.	III	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	08	60	140	200
			Total	24	180	420	600