SYLLABUS

MASTER OF SCIENCE- CHEMISTRY

(TWO YEAR FULL TIME PROGRAMME)

(FOUR SEMESTER COURSE)

Year 2021-2023

Department of Chemistry

School of Basic & Applied Science

Lingaya's Vidyapeeth, Faridabad

Deemed to be university (u/s of UGC act 1956)

(Approved By UGS, MHRD, AICTE, BCI, PCI & ACI)

SCHEME OF EXAMINATION

(Continuous Assessment and End-Semester Examination)
Theory Courses

Sub-component	**Weightage**
MID-Semester Examination	**25**
Assignment/Quiz/Tutorial/Viva-voce (**ABQ**)	**15**
End-Semester Examination	**60**

Practical Components/Practical Courses

Examination	**Sub-component**	**Weightage**	**Total**
Internal examination	Viva-voce + Continuous lab performance	**20+20**	**40**
End-Semester Practical Exam (External examination)	Viva-voce + Written exam + Practical record file	**20+25+15**	**60**

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PROGRAMME STRUCTURE
M.Sc. Chemistry

Semester	Course No.	Course Code	Course Name	Credit/week
I (Odd)	1.	MCH–101	Organic Chemistry-I	3+1+0 = 4
	2.	MCH–103	Physical Chemistry-I	3+1+0 = 4
	3.	MCH–105	Inorganic Chemistry-I	3+1+0 = 4
	4.	MCH–151	Organic Chemistry-Lab-I	0+0+3 = 2
	5.	MCH–153	Physical Chemistry- Lab-I	0+0+3 = 2
	6.	MCH–155	Inorganic Chemistry- Lab-I	0+0+3 = 2
			Total	18
II (Even)	7.	MCH–102	Advance Organic Chemistry	3+1+0 = 4
	8.	MCH–104	Advance Physical Chemistry	3+1+0 = 4
	9.	MCH–106	Advance Inorganic Chemistry	3+1+0 = 4
	10.	MCH-108	Analytical Chemistry-I	3+1+0 = 4
	11.	MCH–152	Advance Organic Chemistry-Lab	0+0+3 = 2
	12.	MCH–154	Advance Physical Chemistry- Lab	0+0+3 = 2
	13.	MCH–156	Advance Inorganic Chemistry- Lab	0+0+3 = 2
			Total	22
III (Odd)	14.	MCH–201	Spectroscopy	3+1+0 = 4
	15.	MCH–203	Nanotechnology and Photochemistry	3+1+0 = 4
	16.	MCH–205	Bioinorganic Chemistry	
	17.	MCH–207	Heterocyclic Chemistry	3+1+0 = 4
	18.	MCH–209	Chemistry of Natural Product	3+1+0 = 4
	19.	MCH–251	Chemistry- Lab	0+0+3= 2
	20.	MCH–253	Synopsis Seminar	0+0+2= 1
	21.	MCH–255	**Dissertation** (Literature Search and Review; Synopsis Submission)	0+0+8 = 4
			Total	23
IV (Even)	22.	MCH–252	**Dissertation** (Literature Search and Review; Thesis Submission)	0+0+40 = 20
			Total	20
Total Credits				83

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PROGRAM OUTCOMES (PO'S)

PO-1: Identify and resolve complex scientific issues in national and local level.

PO-2: Analyze and interpret data using analytical instruments to investigate chemical problems.

PO3: To solve chemical problems, choose, plan, and implement suitable experiment techniques, as well as instrumentation handling.

PO-4: Recognize and use contextual multidisciplinary information to evaluate societal, health, safety, and global problem that are important to research practices.

PO-5: Adopt scientific ideas about environmental use and long-term sustainability.

PO6: Enhance skills for future employability through activities such as seminar, communication skills, industrial visit, and internship.

PO-7: Recall the chemistry courses that are available for competitive test.

PO8: The students attain sound knowledge in the areas of organic, inorganic, physical, pharmaceutical chemistry and material for pursing higher education and research.

PROGRAM SPECIFIC OUTCOMES (PSO'S)

PSO 1: Understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomenon and their relevancies in the day-to-day life.

PSO 2: Apply advanced concepts of Inorganic, Organic, physical and analytical chemistry for the benefit of human being.

SEMESTER-I

MCH-101 : ORGANIC CHEMISTRY-I
(Semester I)

L+T+P	:	**3+1+0**	Mid-Sessional exam	:	**25**
Credits:	:	**4**	ABQ	:	**15**
Contact hours	:	**52**	End-semester exam	:	**60**

COURSE OBJECTIVES:

1. Differentiate chiral and achiral molecules.
2. Recognize and draw structural isomers (constitutional isomers), stereoisomers including enantiomers and diastereomers, racemic mixture, and meso compounds.
3. Identify the stereo centers in a molecule and assign the configuration as R or S.

COURSE OUTCOMES:

CO1. To learn the configuration of stereo centers and applications of configuration on various molecule such as Allenes, biphenyls, cyclophanes etc.

CO2. Students will understand Cyclostereoisomerism and Asymmetry induction in stereochemistry.

CO3. To learn the involvement of reactive intermediates and understand their generation, structure and reactivity.

CO4. To learn the Classical and non-classical, Neighbouring group participation, molecular rearrangements in acyclic, monocyclic and bicyclic systems.

Unit	Contents	Lectures
I	**Stereochemistry-I:** Molecular Symmetry and Chirality: Symmetry operations and elements, point groups and symmetry number. Stereoisomerism: classification, racemisation, molecules with one, two or more chiral centres, DL, RS and EZ nomenclature. Planar and axial chirality. Stereochemistry of allenes, spiranes, alkylidine cycloalkanes, catenanes, biphenyls, bridged biphenyls and cyclophanes	13
II	**Stereochemistry-II:** Topicity of ligands & faces and their nomenclature, stereogenicity, pseudoasymmetry, stereogenic and prochiral centres. Simple chemical correlation of configurations with examples, Quasiracemates. Cyclostereoisomerism: configuration, conformation, stability of cyclohexanes (mono, di and tri-substituted), Cyclohexenes, cyclohexanones, halocyclohexanones. Asymmetry induction: Cram's, prelog's and Horeau's rules; Dynamic stereochemistry (acyclic and cyclic) Curtin-Hammett Principle, Circular Dichromism and cotton effect.	12
III	**Reactive Intermediates-I:** Linear free energy relationships and their applications (Hammett equation). Carbocations: Classical and non-classical, Neighbouring group participation, molecular rearrangements in acyclic, monocyclic and bicyclic systems, stability and reactivity of bridged-head carbocations.	9
IV	**Carbanions:** Generation, structure and stability, ambident ions and their general reactions; HSAB principle and its application. Radicals: Generation, structure and stability and reactions, radical cations and anions.	9
V	**Carbenes:** Formation and structure, reactions involving carbenes and carbenoids. Nitrenes: Formation, structure, reactions of nitrenes. Nucleophilic aromatic substitution: Benzynes. SNAr and SRN1 mechanisms; Ipso effect.	9

TEXTBOOKS/REFERENCE BOOKS:

1. F. A. Carey and R. A. Sundberg, Advanced Organic Chemistry, Part B: Reactions and Synthesis, 5th edition, Springer, New York, 2007.
2. W. Carruthers and I. Coldham, Modern methods of Organic Synthesis, First South Asian Edition 2005, Cambridge University Press.
3. J. March and M. B. Smith, March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, 6th Edition, Wiley, 2007.

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	1	1	-	1	-	3	3	2	3
CO2	3	2	1	-	1	-	3	3	2	3
CO3	2	2	1	-	-	-	3	3	2	3
CO4	3	-	1	3	1	-	3	3	2	3

MCH-103 : PHYSICAL CHEMISTRY-I (Semester I)					
L+T+P	:	**3+1+0**	Mid-Sessional exam	:	**25**
Credits:	:	**4**	ABQ	:	**15**
Contact hours	:	**52**	End-semester exam	:	**60**

COURSE OBJECTIVES:
Recognize the most significant and elementary solutions of Schrodinger equation in molecular quantum mechanics through a study of time independent perturbation theory, valence bond and molecular orbital theories.

COURSE OUTCOMES:
CO1. Students will understand the elementary principles and postulates of quantum mechanics.
CO2. To learn about the concept of various operators in quantum mechanics.
CO3. Students will understand the concept and application of Huckel molecular orbital theory for conjugated systems.
CO4. To learn the concept and application of perturbation theory and variation methods.

Unit	Contents	Lectures
I	**Quantum Chemistry:** Postulates of quantum mechanics, Linear and Hermition operator, Commutation of operators and uncertainty principles. Differential equations, partial differential equations, series solutions and special functions, linear vector spaces, transformations of coordinate matrix, representation of operators, orthonormal sets Fourier and Laplace transforms.	13
II	**Some Exactly Soluble Problems:** Particle in a box and ring. Concept of degeneracy and Jahn-Teller distortion. Simple harmonic oscillator problem and its solution using series solutions or factorization method. Calculation of various average values using ladder operators and recursion relations of Hermite polynomials. Angular momentum operators. Eigen values and eigen functions. Ladder operators. Rigid rotator and hydrogen atom: Complete solution. Radial distributions. Virial theorem.	13
III	**Homo Method and its Applications:** π-Electron approximation, Huckel molecular orbital theory of conjugated systems, calculation of properties-delocalization energy, electron density, bond order, alternant and non-alternant hydrocarbons, pairing theorem**.**	11
IV	**Approximate Methods-I:** First order time-independent perturbation theory for non degenerate states. Variation theorem and variation methods. Use of these methods illustrated with some examples (particle in a box with a finite barrier, anharmonic oscillator, and approximate functions for particle in a box and hydrogen atom).	8
V	**Approximate Methods-II:** Ground and excited state of helium atom. Pauli's exclusion principle. Many-electron atoms. Concept of spin and determinantal wave functions.	7

TEXT BOOKS/REFERENCE BOOKS:
1.P. W. Atkins and R. S. Friedman, Molecular Quantum Mechanics, Oxford University Press, Oxford, 2004. (Must for Quantum Chemistry basics)
2. Quantum Chemistry by RK Prasad
3. Quantum Chemistry by Era Levine (For Advance Quantum Chemistry)
4. Elementary Quantum Chemistry by Frank Pilar, Mineola, N.Y. Dover, 2001

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	1	1	-	1	-	3	3	2	3
CO2	3	2	1	-	1	-	3	3	2	3
CO3	2	2	1	-	-	-	3	3	2	3
CO4	3	-	1	3	1	-	3	3	2	3

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MCH-105: INORGANIC CHEMISTRY-I (Semester I)					
L+T+P	:	**3+1+0**	Mid-Sessional exam	:	**25**
Credits:	:	**4**	ABQ	:	**15**
Contact hours	:	**52**	End-semester exam	:	**60**

COURSE OBJECTIVES:

Reaction mechanisms are thoroughly discussed with emphasis on ligand substitution, oxidative addition, reductive elimination, insertion and elimination reactions, nucleophilic and electrophilic addition and abstraction at ligands, and the involvement of carbenes in metathesis and polymerization

COURSE OUTCOMES:

CO1. At the end of the course, the learners should be able to: Identify the structure and bonding aspects of simple organometallic compounds.

CO2. Apply different electron counting rules to predict the shape/geometry of low and high nuclearity metal carbonyl clusters.

CO3. Identify the different types of organometallic reactions and apply the above concepts to explain different catalytic reactions.

CO4. To learn the magnetic properties of Transition metal complexes.

Unit	Contents	Lectures
I	**Metal Ligand Equilibria in Solution:** Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate Effect and its thermodynamic origin, determination of binary formation constants by pH-metry and Spectrophotometry.	12
II	**Non–Aqueous Solvents:** Role of Solvents in chemical reactions, physical properties of a solvent, types of solvent and their general characteristics, reactions in non-aqueous solvents with reference to liquid ammonia and liquid SO_2.	11
III	**Magnetic Properties of Transition Metal Complexes:** Magnetic properties of transition metal complexes and lanthanides, spin-orbit coupling and susceptibility of transition metal ions and rare earths; magnetic moments of metal complexes with crystal field terms of A, E and T symmetry, T.I.P., intramolecular effects, antiferromagnetism and ferromagnetism of metal complexes, super paramagnetism. High and low spin equilibria, anamolous magnetic moments, magnetic exchange coupling and spin Crossover.	10
IV	**Inorganic Materials:** Introduction to the solid state, metallic bond, band theory (zone model, brillouin zones, limitation of zone model): defects in solids, *p*-type and *n*-type, inorganic semiconductors (use in transistors, IC etc.), electrical, optical, magnetic and thermal properties of inorganic materials, superconductors, with special emphasis on the synthesis and structure of high temperature super conductors.	10
V	**Metal Clusters:** Higher boranes, carboranes and metalloboranes, compounds with metal –metal multiple bonds metal carbonyls and halide clusters.	9

TEXT BOOKS/REFERENCE BOOKS:

1. Inorganic Reaction Mechanism - F. Basolo & G. Pearson.

2. Inorganic Reaction Mechanism - J. O. Edwards.

3. Selected Topics in Inorganic Chemistry- Malik, Madan & Tuli.

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	1	1	-	1	-	3	3	2	3
CO2	1	2	1	-	1	-	3	3	2	3
CO3	2	2	1	-	-	-	3	3	2	3
CO4	2	-	1	3	1	-	3	3	2	3

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MCH-151: ORGANIC CHEMISTRY Lab-I
(Semester I)

L+T+P	:	**0+0+3**	Viva-voce + Continuous lab performance	:	**40**
Credits:	:	**2**			
Contact hours	:	**52**	Viva-voce + Written exam + Practical record file	:	**60**

COURSE OBJECTIVES:
The objective of the course Laboratory is to expose the students of M.Sc. class to experimental techniques in electronics, so that they can verify some of the things read in theory here or in earlier classes and develop confidence to handle sophisticated equipment.

COURSE OUTCOMES:
1. To learn the qualitative analysis of functional group compounds.
2. Lab/Instrumentation techniques used for analyzing reaction mechanisms.
3. To learn the concept of analytical chemistry (Paper chromatography) for separation of compounds.

S. No.	Practical Description
1.	Qualitative analysis of mono and bi-functional compounds.
2.	Purification of organic compounds by crystallization using the following solvents: a. Water b. Alcohol c. Alcohol-Water
3.	Separation of a mixture of two sugars by ascending paper chromatography
4.	Determination of the melting points of given organic compounds and unknown organic compounds
5.	Synthesis of Organic compounds using Acetylation Reaction
6.	Synthesis of Organic compounds using Bromination Reaction
7.	Synthesis of Organic compounds using Diazotization reactions and Aldol reaction
8.	Determination of Acid value of oils

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	1	3	1	1	-	1	3	3	2
CO2	1	2	3	-	1	-	2	3	3	2
CO3	2	2	3	-	-	-	2	3	3	3

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MCH-153: PHYSICAL CHEMISTRY Lab-I
(Semester I)

L+T+P	:	**0+0+3**	Viva-voce + Continuous lab performance	:	**40**
Credits:	:	**2**			
Contact hours	:	**52**	Viva-voce + Written exam + Practical record file	:	**60**

COURSE OBJECTIVES:
1. The course provides training in advanced physical chemistry laboratory techniques.
2. The experiments are guided by demonstrators and are designed both to illustrate applications of theory covered in the Chemical Physics and lecture courses, and to introduce typical instrumentation

Course Outcomes:
CO1. To learn the concept of chemical kinetics and thermodynamic parameters
CO2. To learn the concept of determination of electrochemistry.
CO3. To understand the concept of titration.

S. No.	Practical Description
1.	Determine the specific rate constant for the acid catalyzed hydrolysis of methyl acetate by the initial rate method.
2.	Study the reaction at two different temperatures and calculate the thermodynamic parameters.
3.	Determine the cell constant of the given conductivity cell at room temperature and study the equivalent conductance versus square root of concentration relationship of a strong electrolyte (KCl or NaCl) and weak electrolyte (acetic acid).
4.	Determine the equivalent conductance, degree of dissociation and dissociation constant (Ka) of acetic acid.
5.	Study the conductometric titration of acetic acid vs. sodium hydroxide
6.	Titrate hydrochloric acid and sodium hydroxide potentiometrically
7.	Titrate oxalic acid and sodium hydroxide potentiometrically.
8.	Determine the equivalent conductance at infinite dilution for acetic acid by applying Kohlrausch's law of independent migration of ions.

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	1	3	1	1	-	1	3	3	2
CO2	1	2	3	-	1	-	2	3	3	2
CO3	2	2	3	-	-	-	2	3	3	3

MCH-155: INORGANIC CHEMISTRY Lab-I
(Semester I)

L+T+P	:	**0+0+3**	Viva-voce + Continuous lab performance	:	**40**
Credits:	:	**2**			
Contact hours	:	**52**	Viva-voce + Written exam + Practical record file	:	**60**

COURSE OBJECTIVES:

1. The main objective of volumetric analysis is to determine the amount of a substance in a given sample.
2. Recognize many fundamental bond forming reactions and how to apply them in synthesis
3. When dealing with volumetric analysis the concept of concentration cannot be avoided.

COURSE OUTCOMES:

1. To learn the concept of synthesis Inorganic compounds,

2. To learn the concept of conductivity of ions.

3. To learn the concept of Cis-trans isomerism of inorganic compounds.

S. No.	Practical Description
1.	Preparation of $[Cu(NH_3)_4]SO_4.H_2O$
2.	Synthesis of $[Co(NH_3)_5Cl]Cl_2$
3.	Preparation of $[Ni(NH_3)_6]Cl_2$
4.	To determine the molar conductance of $[Co(NH_3)_5]Cl_3$, and [Co(NH3)5Cl]Cl2 by measuring conductivity of these compounds.
5.	To determine the number of chloride ions in the [Co(NH3)5]Cl3 and [Co(NH3)5Cl]Cl2
6.	Synthesis of trans-dichlorobis (ethylenediamine) cobalt (III) Chloride
7.	Synthesis of cis-Dichlorobis(ethylenediamine)cobalt (III) Chloride

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	1	3	1	1	-	1	3	3	2
CO2	1	2	3	-	1	-	2	3	3	2
CO3	2	2	3	-	-	-	2	3	3	3

SEMESTER-II

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MCH-102: ADVANCE ORGANIC CHEMISTRY
(Semester II)

L+T+P	:	**3+1+0**	Mid-Sessional exam	:	**25**
Credits:	:	**4**	ABQ	:	**15**
Contact hours	:	**52**	End-semester exam	:	**60**

COURSE OBJECTIVES:

1.This course will give an introduction to catatyltic reagents, oxidation chemistry and reaction intermediates..

2.To impart the students in depth knowledge about the basic concepts and theory of pericyclic reactions and to get an idea about the orbital overlap in chemical reaction.

COURSE OUTCOMES:

CO1. The students will be able to understand various catalytic reagents and their activity in the reactions.

CO2. The students will be able to understand oxidation chemistry and coupling reactions.

CO3. To learn about the addition reactions on c-c multiple bond.

CO4. The students will be able to understand about the structure, generation and stability of the reaction intermediates.

CO5. Students will learn in depth knowledge about the basic concepts and theory of Pericyclic reactions.

Unit	Contents	Lectures
I	**Organic Synthetic Methodology:** Reduction Chemistry: Stereochemistry and selectivity of catalytic hydrogenation along with the mechanism, Applications of Lithium aluminium hydride, Sodium borohydride, sodium cyanohydride, alkoxy substituted LAH, DIBAL, diborane, diisoamylborane, thexyborane, 9-BBN as reducing agents, Homogeneous hydrogenation mechanism using Ru and Rh metal complexes along with its applications.	**14**
II	**Oxidation Chemistry**: Sharpless epoxidation, Applications of DDQ, SeO_2, $Tl(NO_3)_3$. Coupling Reactions with Pd(0) and Pd(II): Stille, Suzuki and Sonogashira coupling, Heck reaction and Negishi coupling.	**9**
III	**Addition to Carbon-Carbon Multiple Bonds:** Mechanistic and stereochemical aspects of addition reaction involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity, orientation and reactivity. Addition to cyclopropane rings. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration, Michael reaction and Sharpless asymmetric epoxidation.	**11**
IV	**Reactive intermediates In Organic Reactions:** *Carbocations:* Stability and structure, generation and fate of carbocations. Nonclassical carbocations neighbouring group participation, ion-pairs, molecular rearrangements in acyclic, monocyclic and bicyclic systems, stability and reactivity of bridge-head carbocations. Bredts rule; *Carbanions:* Stability, structure, generation and fate, ambident ions and their general reactions; Carbon free radicals: Stability and structure, generation and fate of free radicals, captodetive effects; radical-ions; *Carbenes:* Formation and structure, reactions involving carbenes and carbenoids. *Nitrenes:* Generation, structure and reactions of nitrenes; *Benzynes:* Generation, structure and reactions of benzynes; Nucleophilic substitution at aryl carbon via Meseinheimer complex.	**9**
V	**Pericyclic Reactions:** Electrocyclic, cycloaddition, sigmatropic and chelotropic reactions; General Orbital Symmetry rules, Frontier Orbital approach, PMO approach, Correlation diagrams for different systems, Hückel–Mobius approach, General pericyclic selection rule and its applications, 1,3-dipolar additions, Ene	**9**

	reaction	

TEXTBOOKS/REFERENCE BOOKS:

1. Advanced Organic Chemistry; Jerry March, Fourth edition, Wiley & Sons, (2007).
2. Mechanisms in Organic Chemistry; Peter Sykes, Sixth edition, Pearson, (2004).
3. Organic Chemistry; Solomons & Fryhle, Eighth edition, Wiley & Sons, (2007).

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	1	1	-	1	-	3	3	2	3
CO2	1	2	1	-	1	-	3	3	2	3
CO3	2	1	1	-	-	-	3	3	2	3
CO4	2	2	1	3	1	-	3	3	2	3
CO5	2	2	1	-	2	-	3	3	2	3

MCH-104: ADVANCE PHYSICAL CHEMISTRY
(Semester II)

L+T+P	:	**3+1+0**	Mid-Sessional exam	:	**25**
Credits:	:	**4**	ABQ	:	**15**
Contact hours	:	**52**	End-semester exam	:	**60**

COURSE OBJECTIVES:

1. The students will be able to understand different types of classification of polymers and sequence determination structure and synthesis of bio-polymers.
2. The students will be able to understand introduction of electrochemistry, chemical kinetics and adsorption.
3. To study the various factors which affect the rate of a chemical reaction such as concentration, temperature, solvent, catalyst etc.

COURSE OUTCOMES:

CO1. Students will able to understand introduction, clasiification and activity of macromolecules and polymer chemistry

CO2. Course will give the understanding to students, determination of transport number and Maxwell-Boltzmann distributions, Debye-Huckel theory and activity coefficients.

CO33.Course will give the understanding to students, about the electrochemical properties of materials solubility of sparingly soluble salt,

CO4.To learn the Catalytic activity at surfaces. on metal surfaces, Metal oxide surfaces. Application of photoelectron spectroscopy.

Unit	Contents	Lectures
1	**Macromolecules:** Concepts of number average and mass molecular weights. Methods of determining molecular weights (cetylati, viscometry, sedimentation equilibrium methods). Distribution of chain lengths. Average end-to-end distance.	10
11	**Polymer Chemistry**: Definition, Classification of polymers, Chain configuration of macromolecules, Isotactic polymers, Atactic polymers, Syndiotactic polymers, Graft polymers, Electrically conducting polymers, Polymerizations reactions, Kinetics of polymerization, Mechanism of polymerization. Molecular mass of polymers, Number and Mass average molecular mass, Determinations of molar masses of polymers (Osmometry, Viscometry and Light scattering methods), Sedimentation, Calculation of average dimensions of various chain structures.	12
111	**Solution Kinetics:** Factors affecting reaction rates in solution. Effect of solvent and ionic strength (primary salt effect) on the rate constant. Secondary salt effects.	8
1V	**Electrochemistry:** Solutions: Activity coefficients and ion-ion interactions. Physical significance of activity coefficients, mean activity coefficient of an electrolyte and its determination. Derivation of Debye-Huckel theory of activity coefficients (both point ion size and finite ion size models). Excess functions.	11
V	**Adsorption.** Surface tension, Capillary action, Pressure difference across curved surface (Laplace equation), Vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, BET adsorption isotherm, Surface films (Electro-kinetic phenomenon), Catalytic activity at surfaces. Catalysis: on metal surfaces, Metal oxide surfaces. Application of photoelectron spectroscopy, ESCA and Auger	11

	spectroscopy to the study of surfaces.	

TEXTBOOKS/REFERENCE BOOKS:

1. Physical Chemistry 8th Ed., P. W. Atkins and J. de Paula, Oxford University Press, 2006.
2. Physical Chemistry of Surfaces – A. W. Adamson – John Wiley Sons.
3. Catalytic Chemistry, Bruce C. Gates, John Wiley & Sons, Inc. 1992.(541.395 GAT)

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	2	1	-	1	-	3	3	2	3
CO2	1	2	1	-	1	-	3	3	2	3
CO3	1	2	1	-	-	-	3	3	2	3
CO4	2	2	1	3	1	-	3	3	2	3

MCH-106: ADVANCE INORGANIC CHEMISTRY
(Semester II)

L+T+P	:	**3+1+0**	Mid-Sessional exam	:	**25**
Credits:	:	**4**	ABQ	:	**15**
Contact hours	:	**52**	End-semester exam	:	**60**

COURSE OBJECTIVES:

1. This course is aimed to provide the students with a solid understanding of all the fundamental concepts in modern inorganic chemistry necessary for the study of the more advanced or specialized courses that follow.
2. The topics discussed include coordination chemistry, group theory and nuclear chemistry.

COURSE OUTCOMES:

CO1.Course will give the understanding to students, about the symmetry of the molecules

CO2. Student will be able to use Crystal Field Theory to understand the magnetic properties of coordination compounds.

CO3. Student will be able to understand the stereochemistry and bonding in main group compounds.

CO4.Student will be able to understand nuclear binding energy and nuclear reactions in chemistry.

Unit	Contents	Lectures
I	**Group Theory And Its Applications:** Symmetry elements and symmetry operations, Groups, subgroups, classes and its characteristics, products, classes and application of symmetry opkerations, Point group classification. Reducible and irreducible representations, character table, Wave functions for irreducible representations (p- and d- block only), Russell-Saunders coupling, vibronic coupling, non-cetrosymmetric complexes.	**15**
II	**Electronic Spectra of Transition Metal Complexes:** Spectroscopic ground states, correlation, crystal field theory and splitting in Oh, Td, D4h and C4v systems, orgel and Tanabe-Sugano diagrams for transition metal complexes (d1 –d9),Calculation of Dq, B and β Parameters ,charge transfer spectra, spectroscopic method for assignment of absolute configuration inoptically active metal chelate and their cetylation al information.	**14**
III	**Stereochemistry and Bonding in Main Group Compounds**: VSEPR, Walsh diagram (tri- and penta atomic molecules), dπ-pπ bonds, Bent rule and energetic of hybridization, simple reactions of covalently bonded molecules.	**8**
IV	**Nuclear Binding Energy**: Justifications And Applications; Nuclear Stability Rules And Decay Of Unstable Nuclei. Nuclear Structure: Nuclear Force, Liquid Drop Model, Shell Model And Collective Mode.	**7**
V	**Nuclear Reactions**: Energetics of nuclear reactions; various types of nuclear reactions including photonuclear, thermonuclear and spallation reactions; mechanism of nuclear reaction by compound nucleus model. Nuclear fission – Fission probability; energy release; theories of fission. Nuclear Fussion: Brief idea about breeder reactors.	**8**

TEXTBOOKS/REFERENCE BOOKS:

1. Chemical Applications of Group Theory: by F.A. Cotton.
2. Group Theory and Symmetry in Chemistry: by Lowell H. Hall, Butterworth (1996).

3. H. J. Arnikar, Essentials of Nuclear Chemistry, Wiley Eastern Ltd. (1995).
4. B. K. Sharma, Nuclear and Radiation Chemistry, Krishna Publication.

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	1	1	-	1	-	3	3	2	3
CO2	1	2	1	-	1	-	3	3	2	3
CO3	1	1	1	-	2	-	3	3	2	3
CO4	2	2	1	3	2	-	3	3	2	3

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MCH-108: ANALYTICAL CHEMISTRY-I (Semester II)					
L+T+P	:	**3+1+0**	Mid-Sessional exam	:	**25**
Credits:	:	**4**	ABQ	:	**15**
Contact hours	:	**52**	End-semester exam	:	**60**

COURSE OBJECTIVES:

Provide theoretical background and develop practical skills to students using modern analytical methods and instruments.

COURSE OUTCOMES:

1. Analytical chemistry gives a good perspective of the theories underlying the elimination of interfering radicals in the qualitative mixture analysis.
2. Develops accuracy and precision in doing experiments, understands the different errors and methods for minimizing errors.
3. Students will be able to understand the countercurrent extraction and fractional distillation.
4. Students will be able to understand the introduction and application of gas and High pressure chromatography techniques.

Unit	Contents	Lectures
I	**Introduction To Analytical Chemistry:** Scope & objectives, Analytical chemistry and chemical analysis, Classification of analytical methods, Method selection, Sample processing, Steps in a quantitative analysis, Quantitative range, Data organization, Analytical validations, Limit of detection and limit of quantization, The tools of analytical chemistry and good lab practices.	**12**
II	**Errors in Chemical Analysis and Statistical Evaluation of Data:** Systematic and random errors, Accuracy and precision, Ways of expressing accuracy and precision, Propagation of error, Useful statistical test: test of significance, the F test, the student 't' test, the chi-test, the correlation coefficient, comparison of two standard values, comparison of standard deviation with average deviation, comparison of mean with true values, significant figures, regression analysis (least-square method for linear plots), statistics of sampling and detection limit evaluation.	**14**
III	**Separation Methods: Multiple Liquid-Liquid Extraction:** Countercurrent extraction, Craig's tube and Craig's apparatus, distribution of single solute, Gaussian treatment in describing distribution pattern of solute fraction in r^{th} tube after n-transfers. Fractional Distillation: Temperature composition diagram of a binary system, concept of theoretical plates, HETP, Bubble-cap distillation column and derivation of Fenske equation.	**10**
IV	**Gas Chromatography:** Introduction, principle of gas chromatography, instruments for gas-liquid chromatography, detectors:- thermal conductivity detector, flame ionization detector, electron capture detector and others, gas chromatographic columns and stationary phases, factors affecting the efficiency of the column, resolution, retention time and other basic parameters. Interpretation of gas chromatograms. Qualitative analysis, Kovats retention index (I), Quantitative analysis, measurement of peak area, response factor; Applications of gas chromatography.	**9**
V	**High Performance Liquid Chromatography (HPLC):** Basic difference between HPLC and conventional liquid chromatography with respect to sample applications, packing materials and equipments, detectors. Advantages and applications.	**7**

TEXTBOOKS/REFERENCE BOOKS:

1. Inczedy, J. Analytical applications of complex equilibria Halsted Press: New York, NY (1976).
2. Ringbom, A. Complexation in Analytical Chemistry Wiley: New York (1963).

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	1	2	-	1	-	3	3	2	3
CO2	1	2	3	-	1	-	3	3	2	3
CO3	1	3	3	-	2	-	3	3	2	3
CO4	2	3	3	3	2	-	3	3	2	3

MCH-152: ADVANCE ORGANIC CHEMISTRY LABORATORY
(Semester II)

L+T+P	:	**0+0+3**	Viva-voce + Continuous lab performance	:	**40**
Credits:	:	**2**			
Contact hours	:	**52**	Viva-voce + Written exam + Practical record file	:	**60**

COURSE OBJECTIVES:

1. Students will employ the major techniques used in organic chemistry laboratory for analyses such as melting point determination, extraction, chromatography, infrared spectroscopy, distillation and chemical characterization tests.
2. Students will develop better understanding of the organic chemistry behind everyday observations such as the action of soap, or application of color dyes on variety of fabrics

COURSE OUTCOMES:

CO1. Determination of percentage of hydroxyl group.
CO2. To understand the main organic reactions in experimentally.
CO3. To learn the concept of saponification values in oil.

S. No.	Practical Description
1.	Determination of percentage of hydroxyl group by Acetylation method ii. by Bromination method
2.	Estimation of amino group i. by Acetylation method ii. by bromination method
3.	Organic synthesis using some of the following reactions i. Coupling reaction iii. Oxidations and reductions iv. Grignards reaction
ii.	Determination of I_2 value of oils
iii.	Determination of Saponification value of oils

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	1	3	1	1	-	1	3	3	2
CO2	1	2	3	-	1	-	2	3	3	2
CO3	2	2	3	-	-	-	2	3	3	3

MCH-154: ADVANCE PHYSICAL CHEMISTRY LABORATORY
(Semester II)

L+T+P	:	**0+0+3**	Viva-voce + Continuous lab performance	:	**40**
Credits:	:	**2**			
Contact hours	:	**52**	Viva-voce + Written exam + Practical record file	:	**60**

OBJECTIVES:
The objective of the course is to present a theory of classical electrodynamics and analytical methods.
Course Outcomes:
CO1. To implement the concept of viscosity and surface tension method on liquid mixture.
CO2. To understand the concept of saponification values.
CO3. To understand the concept of chemical kinetics on reaction rate.

S. No.	Practical Description
1.	Determine the percentage composition of a liquid mixture by viscosity method.
2.	Determine molar surface energy of ethyl alcohol by surface tension.
3.	To find out composition of a unknown solution by surface tension measurement
4.	Verify the law of refraction for mixtures, using glycerol and water.
5.	Determine the formation of compounds between two liquids in the mixture.
6.	Study the saponification of ethyl acetate by sodium hydroxide solution.
7.	Compare the strengths of hydrochloric acid and sulphuric acid by studying the rate of hydrolysis of methyl acetate.
8.	Determine the specific reaction rate of the potassium persulphate iodide reaction by initial rate method.

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	1	3	1	1	-	1	3	3	2
CO2	1	2	3	-	1	-	2	3	3	2
CO3	2	2	3	-	-	-	2	3	3	3

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MCH-156: ADVANCE INORGANIC CHEMISTRY LABORATORY
(Semester II)

L+T+P	:	**0+0+3**	Viva-voce + Continuous lab performance	:	**40**
Credits:	:	**2**			
Contact hours	:	**52**	Viva-voce + Written exam + Practical record file	:	**60**

OBJECTIVES: To understand the concept of basic principle of inorganic chemistry by preparation of Inorganic compound.

Course Objectives:

CO1. To learn the concept of synthesis of inorganic compounds.
CO2. Implementation of analytical methods for separation and determination of metal ions.
CO3. Determination of metals ions via spectrophotometric methods.

S. No.	Practical Description
1.	**Preparation of the following inorganic compounds** (I) $VO(acac)_2$ (II) (II) Cis-$K[Cr(C_2O_4)_2(H_2O)_2$ (III) (III) $Na[Cr(NH_3)_2(SCN)_4]$ (IV) (IV) $K_3[Fe(C_2O_4)_3]$
2.	**Quantitative Analysis** (a) Separation and determination of two metal ions Cu-Ni, Ni-Zn, Cu-Fe, Ba-Cu etc. involving volumetric and gravimetric methods.
3.	**Spectrophotometric Determinations** 1. Ni by extractive Spectrophotometric method. 2. Fe by Job's method of continuous variations 3. Fe in vitamin tablets 4. Nitrite in water in colorimetric method.

TEXTBOOKS/REFERENCE BOOKS:

1. Experimental Inorganic Chemistry by W.G. Palmer, Cambridge.
2. Inorganic Synthesis, MC Graw Hill.
3. Handbook of Preparative Inorganic chemistry Vol. I and II, Academic press.
4. Standard methods of chemical analysis by W.W. Scaff, Technical Press.
5. Vogel's Qualitative Inorganic Analysis (revised), Orient Longman.

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	1	3	1	1	-	1	3	3	2
CO2	1	2	3	-	1	-	2	3	3	2
CO3	2	2	3	-	-	-	2	3	3	3

SEMESTER-III

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MCH-201: SPECTROSCOPY (Semester III)					
L+T+P	:	**3+1+0**	Mid-Sessional exam	:	**25**
Credits:	:	**4**	ABQ	:	**15**
Contact hours	:	**52**	End-semester exam	:	**60**

COURSE OBJECTIVES:

After completing this unit the student will be able to:

1. Explain what it means to use spectroscopic methods for qualitative and quantitative analysis.
2. Identify the terms in and describe deviations to Beer's Law.
3. Qualitatively determine the relative error in absorbance measurements and determine the optimal range for measurement purposes.

COURSE OUTCOMES:

1. Students will be able to explain the symmetry and group theory to the various organic molecules.
2. Students will be able to identify the classification of polyatomic molecules and vibration-rotaion spectroscopy..
3. Students will be able to understand electronic spectroscopy of Polyatomic molecules.
4. Students will understand the principle of mass spectroscopy and its application for the dtermination of molecules.

Unit	Contents	Lectures
I	**Symmetry and Group Theory in Chemistry:** Character tables for C2V and C3V point groups (Construction not required). Representation reducible and irreducible, analysis of reducible representation. Simple Applications of the Character table.	**10**
II	**Infrared Spectroscopy:** Classification of polyatomic molecules. Energy levels and spectra of symmetric top molecules and asymmetric top molecules. First order Stark effect. Vibrational-rotation spectroscopy, P, Q and R branches. Breakdown of Born-Oppenheimer approximation; vibrations of polyatomic molecules, Selection rules, normal modes of vibration, group frequencies, overtones and combination bands, hot bands, factors affecting the band positions and intensities, far IR region, metal-ligand vibrations	**14**
III	**Raman Spectroscopy**: Selection rules, mutual exclusion principle. Polarization of Raman lines. Resonance Raman spectroscopy, coherent anti Stokes Raman spectroscopy (CARS).	**8**
IV	**Electronic Spectroscopy of Polyatomic Molecules:** Energy levels of molecular orbitals, vibronic transitions, vibrational progressions and geometry of excited states, Franck-Condon principle, electronic spectra of polyatomic molecules. Electronic spectra of transition metals Emission spectra: radiative and non-radiative decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra.	**10**
V	**Mass Spectroscopy:** Principle of mass spectroscopy (instrument, operation and representation of spectra), mass spectrometer, interpretation of mass spectra, fragmentation pattern, mode of fragmentation, nitrogen rule, effect of isotopes, signals of doubly charged ion, applications viz; identification of substances, determination of molecular weight and molecular formula.	**10**

TEXTBOOKS/REFERENCE BOOKS:

1. Modern Spectroscopy, J.M. Hollas, John Wiley & Sons (2004).

2. Physical Methods in Chemistry, R.S. Drago, Saunders.
3. Chemical Applications of Group Theory, F.A. Cotton

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	1	2	-	1	-	3	3	2	3
CO2	1	2	3	-	1	-	3	3	2	3
CO3	1	3	3	-	2	-	3	3	2	3
CO4	2	3	3	3	2	-	3	3	2	3

MCH-203: NANOTECHNOLOGY AND PHOTOCHEMISTRY
(Semester III)

L+T+P	:	**3+1+0**	Mid-Sessional exam	:	**25**
Credits:	:	**4**	ABQ	:	**15**
Contact hours	:	**52**	End-semester exam	:	**60**

COURSE OBJECTIVES:

This course introduces the fundamentals of nano-scale engineering and manufacturing. Current and future applications of nanostructured materials will be reviewed with respect to their impact in commercial products and technologies.

COURSE OUTCOMES:

1. Explain the fundamental principles of nanotechnology and their application to biomedical engineering.
2. Apply engineering and chemistry concepts to the nano-scale and non-continuum domain.
3. To learn about the photochemical reactions and their application in hydrogen-bromine and hydrogen-chlorine systems.
4. Students will able to understand the theories of reaction rate and elementary reaction in solutions

Unit	Contents	Lectures
I	**Fundamentals of Nanoscience and Nanotechnology** : Solid materials and their strength, Perspective of length, Nanomaterials, Nanoscience and Nanotechnology, Nanostructures in nature, Prime materials, Carbon nanostructures viz. Carbon nanotube (Single-walled and multi-walled), Fullerenes, Surface effects of Nanomaterials, Surface plasmon resonance, Quantum size effects.	**9**
II	**Applications of Nanomaterials**: Importance of Nanomaterials (Gold, Silver, Dielectric and Magnetic Oxide Nanoparticles), Some selected applications like, Nanomaterials in medicine, Nanomaterials for energy sector, Kinetic energy (KE) penetrators with enhanced lethality, High energy density batteries, Nanomaterials in Next-Generation Computer, Nanomaterials in catalysis and sensors, Nanomaterials for water purification, Nanomaterials in communication sector, Nanomaterials in food, Nanomaterials for the environment, Nanomaterials in automobiles, Nanomaterials in ceramics industry	**11**
III	**Introduction and Basic Principles of Photochemistry** : Energy of a Molecule, Photochemical Energy, Electronic transition, Spin Multiplicity, The fate of excited molecules: Physical Processes: Jablonski Diagram, Photocatalytic Clevage, Laws of Photochemistry: Gratthurs-Drapper Law and Einstein's Law of Photo Chemical Equivalence, Quantum Yield or Quantum Efficiency.	**12**
IV	**Photochemistry of carobonyl compound and photo rearragment:** Alpha cleavage or Norish Type1 Process: Norish Type1 Process given by acyclic saturated ketones, Norish Type1 Reaction of Saturated Cyclic Ketones, Norish Type1 Process given by Cyclopentanones, Alpha Cleavage given by Cyclobutanones, Paterno Buchi Reaction, Aza-Di-Pi Methane Rearrangement , Di-Pi-Methane(DPM) rearrangement.	**11**
V	**Photochemistry in Nature and Applied Photochemistry:** Photochemical Reactions in Atmosphere, Chemistry of Vision, Photography, Light Absorbing Compounds, Photochromism, Photoimaging, Photochemistry of Polymers.	**9**

TEXTBOOKS/REFERENCE BOOKS:

1. Atkins P. W. and De Paula J., Physical Chemistry, (tenth edition) Oxford University Press, 2014.N

2. Poole, C.P. & Owens, F.J. Introduction to Nanotechnology John Wiley 2003).
3. Rohatgi-Mukherjee K. K. Fundamentals of Photochemistry, New age (revised second edition).

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	1	2	-	1	-	3	3	2	3
CO2	1	2	-	-	1	-	3	3	2	3
CO3	1	3	1	-	2	-	3	3	2	3
CO4	2	1	1	1	2	-	3	3	2	3

MCH-205: BIO-INORGANIC CHEMISTRY
(Semester III)

L+T+P	:	**3+1+0**	Mid-Sessional exam	:	**25**
Credits:	:	**4**	ABQ	:	**15**
Contact hours	:	**52**	End-semester exam	:	**60**

COURSE OBJECTIVES:
The objective of the course General Inorganic Laboratory is to expose the students of M.Sc. class to experimental techniques in electronics, so that they can verify some of the things read in theory here or in earlier classes and develop confidence to handle sophisticated equipment.

COURSE OUTCOMES:
1. Detail knowledge about Bioinorganic and supramolecular & photo inorganic chemistry.
2. Metalloenzymes-understanding of metalloenzymes and their functions in human body/living body.
3. Detail knowledge about metal chelates as medicine, study about synthetic approach of antibiotics.
4. Students will understand the toxicity and their remediation of the heavy metals.

Unit	Contents	Lectures
I	**Metallo-Proteins**: Biological ligands for metal ions: Macrocycle, nucleobase, nucleotides and nucleic acids, coordination of metals by protein. Heme and nonheme protein, oxygen uptake, structure and function of haemoglobin, myoglobin, hemocyanin, hemotherine..	**12**
II	**Metalloenzyme**: Principle involved and role of various metals viz. Zn, Fe, Cu and Co; carboxy peptidase, carbonic anhydrase, Alcohol dehydrogenase, Zinc Fingures, other gene regulatory Zinc proteins, cobalomine, mutase activities of coenzyme B12.	**12**
III	**Iron sulphur protein**, cytochromes, cytochrpm P-450, oxygen transfer long distance electron transfer.	**8**
IV	**Application of Bioinorganic Chemistry**: Medicinal and therapic; metal deficiency and disease, toxic effect of metals, metals used for diagnosis and chemotherapy, gold compound as Anti-Rheumatic agent. Nitrogen cycle; biological nitrogen fixation, metalloenzyme in biological nitrogen cycle, molybdenum nitrogenase, other nitrogenase model	**10**
V	**Toxicity of heavy metals** and their detoxification, role of Selenium in Biological systems with reference to its essentiality and toxicity, mechanism of metal ion induced toxicity, interaction between orally administered drugs & metal ions in guts. Drugs in hypo and hyper activity of thyroids, Inorganic drugs in dental carries, clinical disorders of alkali and alkaline earth metals and their remedies, lithium drugs in psychiatry.	**10**

TEXTBOOKS/REFERENCE BOOKS:
1. Principles of Bioinorganic Chemistry S.J. Lippard and J. M. Berg, University Science Books.

2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J. S. Valentine, University Science Books.
3. Inorganic Biochemistry, Vols. I and II, Ed. G. L. Eichhorn, Elsevier.

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	1	2	-	1	-	3	3	2	3
CO2	1	-	-	-	1	-	3	3	2	3
CO3	1	-	1	-	2	-	3	3	2	3
CO4	1	-	1	1	2	-	3	3	2	3

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MCH-207: HETEROCYCLIC CHEMISTRY
(Semester III)

L+T+P	:	**3+1+0**	Mid-Sessional exam	:	**25**
Credits:	:	**4**	ABQ	:	**15**
Contact hours	:	**52**	End-semester exam	:	**60**

COURSE OBJECTIVES:

The course deals with heterocyclic chemistry in a broad perspective. Emphasis is given on the most important heterocyclic systems, such as pyridines, quinolines, isoquinolines, pyrroles, furanes, tiophenes, indoles, pyrimidines, purines, imidazoles, aziridines and oxiranes.

COURSE OUTCOMES:

1. The course aims at giving a fundamental theoretical understanding of heterocyclic chemistry.
2. To learn the alternative general methods for ring synthesis and application of such methods for the preparation of specific groups of heterocyclic systems.
3. The student will get familiar with particular properties and reactions for the most important heterocycles as well as different systems of nomenclature.
4. Students will understand the rearrangements using various name reactions.

Unit	Contents	Lectures
I	**Introduction to Heterocycles:** Nomenclature, spectral characteristics, reactivity and aromaticity.	**12**
II	**Synthesis and Reactions of three and four membered Heterocycles**: Aziridine, azirine, azetidine, oxiranes, thiarines, oxetanes and thietanes.	**12**
III	**Five-membered rings with two Heteroatoms**: pyrazole, imidazole, oxazole, thiazole, isothiazole, benzofused analogs.	**8**
IV	**Bicyclic Compounds:** Bezofused six membered rings with one, two and three heteroatoms: benzopyrans, quinolones, isoquinolines, quinoxazalines, acridines, phenoxazines, phenothiazines, benzotriazines, pteridines.	**10**
V	**Rearrangements:** General mechanistic considerations- nature of migration, migratory aptitude, memory effects, Cationotropic and Anionotropic rearrangements, Pinacol-Pinacolone, Wagner-Meerwein, Demjanov, Dienone-Phenol, Benzilic acid,Favorskii, Arndt-Eistert, Neber, Hoffmann, Losson, Curtius, Schmidt,Beckmann, BaeyerVilliger rearrangements.	**10**

TEXTBOOKS/REFERENCE BOOKS:

1. Smith M.B & March,J. Advanced organic chemistry sixth edition, John Wiley & Sons (2007). 45
2. Carey, F.A. & Sundberg, R. J. Advanced Organic Chemistry, Parts A & B, Plenum: U.S. (2004).
3. Carruthers,W. and Coldham,I. Modern methods of organic synthesis, Cambridge University Press(2004).
4. Eliel, E. L. Stereochemistry of Carbon Compounds Textbook Publishers (2003).

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	1	2	-	1	-	3	3	2	3
CO2	1	-	-	-	1	-	3	3	2	3
CO3	1	-	1	-	2	-	3	3	2	3

CO4	1	-	1	1	2	-	3	3	2	3

MCH-209: Chemistry of Natural Products
(Semester III)

L+T+P	:	**3+1+0**	Mid-Sessional exam	:	**25**
Credits:	:	**4**	ABQ	:	**15**
Contact hours	:	**52**	End-semester exam	:	**60**

COURSE OBJECTIVES:

1. The course provides a brief introduction to plant systematics.
2. Significant poisonous and medicinal plants, together with natural medicines, will be discussed.
3. Important classes of compounds (secondary metabolites) in and from nature will be emphasised, and stress will be put on classification, nomenclature, structure, biosynthesis, occurrence, analysis and pharmaceutical perspectives.

COURSE OUTCOMES:

After completing the course the student will be able to:

1. Provide an overview of the field of natural product chemistry.
2. Identify different types of natural products, their occurrence, structure, biosynthesis and properties.
3. Discuss the use of natural products as starting materials for medicines.
4. **I**ntroduction, structures and functions of DNA and RNAs (m-RNA, t-RNA, r-RNA),

Unit	Contents	Lectures
I	**Alkaloids:** Introduction, occurrence, nomenclature, physiological actions, isolation, methods of structural determination. Structure determination and synthesis of the following alkaloids: Atropine, Coniine. Ephedrine, Morphine, Nicotine and Quinine.	12
II	**Terpenoids and Carotenoids:** Introduction, occurrence, classification, nomenclature, isolation, isoprene rule, methods of structural determination. Structure determination and synthesis of the following molecules: β-Carotene, Citral, Phytol, Terpeneol and Zingiberene.	11
III	**Plants Pigments:** Introduction, occurrence, nomenclature, isolation, methods of structural determination, synthesis of Apigenin, Cyanidine, Cyaniding-7-Arabinoside, Diadzein, Luteolin, Myrcetin, Quercetin, Quercetin-3-Glucoside and vitexin.	10
IV	**Steroids:** Introduction, occurrence, nomenclature, isolation, basic skeleton, Dicl's hydrocarbon and stereochemistry, methods of structural determination. Structure determination and synthesis of the following steroids: Aldosterone, Androsterone, Cholesterol, Estrone, Progesterone and Testosterone.	10
V	**Nucleic Acids: I**ntroduction, structures and functions of DNA and RNAs (m-RNA, t-RNA, r-RNA), Chemical and enzymatic hydrolysis of DNA and RNAs, an overview of gene expression (replication, transcription and translation), genetic coIde (origin, Wobble hypothesis), genetic errors, mutation and carcinogenesis and recombinant DNA technology.	9

TEXT BOOKS/REFERENCE BOOKS:

1. I.L. Finar, Organic chemistry, Vol. II, ELBS Publications, UK.
2. J. Mann, R.S. Devison, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Natural products chemistry and biological significance, Longman Publisher, Essex, UK.

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	2	1	-	1	-	2	3	2	3
CO2	1	2	1	-	1	-	2	3	2	3
CO3	2	2	1	-	-	-	2	3	2	3
CO4	2	2	1	3	1	-	2	3	2	3

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MCH-251: CHEMISTRY LABORATORY
(Semester III)

L+T+P	:	**0+0+2**	Viva-voce + Continuous lab performance	:	**40**
Credits:	:	**2**			
Contact hours	:	**52**	Viva-voce + Written exam + Practical record file	:	**60**

COURSE OBJECTIVES:
1. Students will get acquainted with the unifying principles of spectroscopy.
2. Students will learn atomic absorption spectroscopy, its basic principle, instrumentation and applications.

COURSE OUTCOMES:
1. The students have the detailed knowledge of analytical ore analysis of different element, quantitative organic compound analysis and also have the spectroscopic determination method.
2. Students will learn error analysis, statistical data analysis, volumetric analysis, chromatography, flame photometry.
3. Students will be capable of synthesizing metal complexes.

S. No.	Practical Description
1.	Synthesis of metal acetylacetonate; magnetic, IR, NMR studies
2.	Synthesis of Cis- and Trans-$[Co(en)_2Cl_2$
3.	Magnetic moment of $Cu(acac)_2.H_2O$.
4.	**Spectrophotometric Determination** a. Mn/Cr/V in steel sample b. Mo/W/V/U/ by extractive spectrophotometric method c. $F^-/NO_2^-/PO_4^{3-}$ d. Iron-phenanthroline complex: Jobs method of continous variations. e. Cu-Ethylenediamine complex: Slope-Ratio Method
5.	Fe by Job's method of continuous variations
6.	**Chromatographic Separations** (a) Cd and Zn

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	1	3	1	1	-	1	3	3	2
CO2	1	2	3	-	1	-	2	3	3	2
CO3	2	2	3	-	-	-	2	3	3	3

MCH-253: SYNOPSIS SEMINAR
(Semester III)

L+T+P	:	**1+0+0**	Write up	:	**25**
Credits:	:	**1**	Viva-voce	:	**25**
Contact hours	:	**13**	Presentation	:	**50**

Description
Students are required to submit a synopsis on the allotted topic and must make a presentation in front of advisory committee and M.Sc. Students. Students are expected to provide latest facts and updated information by consulting latest editions of textbooks, reference books, monographs, and peer-reviewed national & international research journals.

S. No.	**Course details**
1.	Synopsis writing
2.	Synopsis seminar
3.	Approval of synopsis by research committee
4.	Research work by taking 13 credit hours

MCH-255: DISSERTATION (Literature Review; Synopsis submission)
(Semester III)

L+T+P : **0+0+4**
Credits: : **4**
Contact hours : **52**

Description
Students are required to work on the allotted topic and must make a presentation in front of advisory committee and M.Sc. Students. Students are expected to provide latest facts and updated information by consulting latest editions of textbooks, reference books, monographs, and peer-reviewed national & international research journals.

S.No.	**Course details**
1.	Research work
2.	Seminar
3.	Evaluation by Research committee
4.	Research work by taking 52 credit hours

SEMESTER-IV

MCH-252: Dissertation (Literature Review; Thesis submission)

(Semester IV)

L+T+P : **0+0+20**
Credits: : **20**
Contact hours : **260**

Description
Semester IV is only for dissertation work. There will be no theory or practical courses in this semester. Dissertation will carry marks for continuous assessment, dissertation write-up, its presentation and viva-voce. This will be evaluated at the end of fourth semester. Students will work on a research topic assigned to him/her by their supervisor/mentor with a purpose to develop a collective approach to study, analyze and solve the problem. Students are required to collect, analyze the data, and submit their dissertation at the end of the semester.

S.No.	**Course details**
1.	Research work
2.	Seminar
3.	Evaluation by Research committee
4.	Thesis writing
5.	Research work by taking 260 credit hours