K.K. UNIVERSITY

NALANDA, BIHAR - 803115

SCHOOL OF APPLIED SCIENCES

MASTER OF SCIENCE (M.Sc.)
CHEMISTRY

(Two Year Full Programme)
2024-2025

PROGRAMME STRUCTURE & SYLLABUS

DEPARTMENT OF CHEMISTRY, K.K UNIVERSITY, BIHARSHARIF

Pro Vice Chancellor
KK University
Berauti, Nepura, Bihar Sharif
Nalanda - 803115 (Bihar)

Programme Structure

Year	Semester	Course code	Course title	L	T	P	C
I	I	MSCH 1101	Physical Chemistry-I	4	1	0	5
		MSCH 1102	Inorganic Chemistry-I	4	1	0	5
		MSCH1103	Organic Chemistry-I	4	1	0	5
		MSCH 1104-P	Practical-I	0	0	10	5
			TOTAL	**12**	**3**	**10**	**20**
	II	MSCH 1201	Physical Chemistry-II	4	1	0	5
		MSCH 1202	Inorganic Chemistry-II	4	1	0	5
		MSCH 1203	Organic Chemistry-II	4	1	0	5
		MSCH 1204-P	Practical-II	0	0	10	5
			TOTAL	**12**	**3**	**10**	**20**
II	III	MSCH 2101	Spectroscopy-II	4	1	0	5
		MSCH 2102	Environmental And Analytical Chemistry	4	1	0	5
		MSCH 2103	Bio-Organic And Bio-Inorganic Chemistry	4	1	0	5
		MSCH 2104-P	Practical-III	0	0	10	5
			TOTAL	**12**	**3**	**10**	**20**
	IV	MSCH 2201	Medicinal Chemistry (Organic)	4	1	0	5
		MSCH 2202	Natural Products (Organic)	4	1	0	5
		MSCH 2203	Heterocyclic Chemistry (Organic)	4	1	0	5
		MSCH 2204-P	Project And Dissertation	0	0	10	5
			TOTAL	**12**	**3**	**10**	**20**
			TOTAL CREDITS				**80**

Course of Dissertation: -

- ✓ Environmental and Analytical chemistry
- ✓ Bio-inorganic Chemistry

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SEMESTER I

PHYSICAL CHEMISTRY

SUB CODE- MSCH 1101

L	T	P	Cr
4	1	0	5

Programme Outcome

PO1: Understand key concepts in Organic, Inorganic, Physical, and Analytical chemistry and describe how these principles are applied.

PO2: Apply chemical knowledge and laboratory techniques to solve problems in both academics and research.

PO3: Analyze experimental data to identify trends, interpret results, and draw logical conclusions.

PO4: Evaluate scientific literature, research findings, and chemical processes to assess their validity, reliability, and potential impact on the field.

PO5: Synthesize information from various sources to design new experiments, develop innovative solutions, and contribute to the advancement of Chemistry.

PO6: Conduct advanced experiments and research projects with precision, record data accurately, and present their findings clearly to contribute to scientific knowledge.

Course Outcome

CO1: Understand key concepts in Chemical Thermodynamics and Statistical Thermodynamics.

CO2: Apply knowledge of thermodynamic and kinetic principles to analyze chemical processes.

CO3: Analyze molecular and surface properties to assess the effects of thermodynamic variables.

CO4: Evaluate reaction mechanisms and the factors influencing kinetics and catalysis.

Course Objective

On completion of the course students will understand fundamental principles of physical chemistry, including thermodynamics, kinetics, electrochemistry, and surface chemistry. They will explore

interdisciplinary connections to analyze the behavior of chemical systems and apply their knowledge in practical laboratory settings, ultimately evaluating the broader implications and applications of chemical principles in scientific and industrial contexts.

Syllabus :

Unit	Content	No. of hours	No. of week
I	**Chemical Thermodynamics** Partial molar properties in ideal gas mixture, Chemical Potential, its determination and variation with temperature and pressure, Gibbs Duhem equation, Fugacity and activity its variation with T and P. Fugacity of a gas mixture.	10	1-3
II	**Statistical Thermodynamics** Partition function and its significance, Relationship with thermodynamic functions, Translational, Rotational, Vibrational and Electronic partition function. Its applications in the case of mono atomic and diatomic molecules.	10	3-6
III	**Surface Chemistry** Surface Tension and Surface free energy on liquids, Vapour pressure of droplets (Kelvin equation), Gibbs adsorption Isotherm, Estimation of surface area. (B.E.T equation), Unimolecular and bimolecular surface reactions	10	6-9
IV	**Chemical Kinetics** Mechanism and Kinetics of consecutive and opposing reactions, Activated complex theory of Uni-molecular reaction, Mechanism and Kinetics of Photolysis of acetaldehyde Polymerization and Auto oxidation reaction, Homogeneous Catalysis, Kinetic of Enzyme catalysis	10	9-12
V	**Electro Chemistry:** Electrode potential in terms of Chemical Potential and activity. Debye Huckle theory of conductance of electrolytic solution Types of Polymers, Kinetics and mechanisms of Polymerization, Molecular mass—number and mass average molecular mass.	10	12-14

VI	**Macro molecules:** Types of Polymers, Kinetics and mechanisms of Polymerization, Molecular mass—number and mass average molecular mass.	10	14-15

Reference Text Books:

- R.C. Mukherjee- Modern Approach to Physical Chemistry (Latest Edition)
- S. Glasstone- Electrochemistry, Thermodynamics, and Chemical Kinetics (Latest Edition)
- Gurdeep Raj & Dr. Harish Kumar - Physical Chemistry (Latest Edition)
- V.K. Gupta & R.G. Sharma - Physical Chemistry (Latest Edition)

Reference Links

- https://ocw.mit.edu/courses/chemical-engineering/10-10-introduction-to-chemical-engineering-thermodynamics-fall-2003/
- https://www.khanacademy.org/science/chemistry
- https://ocw.mit.edu/courses/chemistry/5-12-physical-chemistry-fall-2008/
- https://www.rsc.org/periodic-table/chemistry-terms/thermodynamics

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INORGANIC CHEMISTRY

MSCH 1102

L	T	P	Cr
4	1	0	5

Programme Outcome

PO1: Understand key concepts in Organic, Inorganic, Physical, and Analytical chemistry and describe how these principles are applied.

PO2: Apply chemical knowledge and laboratory techniques to solve problems in both academics and research.

PO3: Analyze experimental data to identify trends, interpret results, and draw logical conclusions.

PO4: Evaluate scientific literature, research findings, and chemical processes to assess their validity, reliability, and potential impact on the field.

PO5: Synthesize information from various sources to design new experiments, develop innovative solutions, and contribute to the advancement of Chemistry.

PO6: Conduct advanced experiments and research projects with precision, record data accurately, and present their findings clearly to contribute to scientific knowledge.

Course Outcome

CO1: Understand stereochemistry and M.O. diagrams for heteronuclear molecules, and explain their effects on molecular bonding.

CO2: Apply magnetochemistry concepts, such as spin-orbit coupling and orbital quenching, to analyze the magnetic behavior of metal complexes.

CO3: Analyze metal-ligand interactions by assessing the limitations of crystal field theory.

CO4: Evaluate reaction mechanisms of transition metal complexes, focusing on hydrolysis, the trans-effect, and electron transfer processes.

CO5: Synthesize principles of bonding and reaction mechanisms to predict the stability and reactivity of transition metal complexes.

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Course Objective

The course aims to provide students with a comprehensive understanding of advanced topics in inorganic chemistry, focusing on transition metal complexes. Students will explore key areas such as stereochemistry, bonding interactions, and molecular orbital diagrams. They will analyze concepts like magnetochemistry and metal-ligand equilibrium in solution and evaluate crystal field theory to understand the behavior and reactivity of transition metal complexes.

Syllabus

Unit	Content	No. of hours	No. of week
I	**Stereochemistry and Bonding:** M.O. diagram for hetero-nuclear di-and triatomic molecules. d π-p π bonds, Bent Rule	10	1-2
II	**Magnetochemistry:** e-e interaction, Term Symbols, spin orbit coupling, Quenching of orbital contribution in metal complexes	10	2-4
III	**Metal-Ligand Equilibrium in Solution** Limitation of crystal field theory (CFT), MOT with σ- &π -bonding.	10	4-6
IV	**Metal ligand Bonding:** Limitation of crystal field theory (CFT), MOT with σ- &π -bonding.	10	6-8
V	**Reaction Mechanism of Transition metal complexes:** Inert and labile complexes Acid hydrolysis, base hydrolysis, CB mechanism, The trans-effect' Electron transfer reactions- inner and outer sphere mechanism.	10	8-11
VI	**Stereochemistry and Bonding**. diagram for hetero-nuclear di-and triatomic molecules' π-p π bonds, Bent Rule	10	11-14

Revision Week			15

Reference Text Books:

- H.L. Cooper, D.F. Shriver, and Peter Atkins - Inorganic Chemistry (Latest Edition)
- J.D. Lee - Concise Inorganic Chemistry (Latest Edition)
- A.Singh - Textbook of Inorganic Chemistry (Latest Edition)
- Gurdeep R. Chhatwal - Advanced Inorganic Chemistry (Part I and Part II) (Latest Edition)
- R.K. Prasad - Quantum Chemistry (Latest Edition)

Reference Links

https://onlinecourses.nptel.ac.in/noc24_cy55/preview
https://ocw.mit.edu/courses/chemistry/5-09-organic-chemistry-spring-2008

ORGANIC CHEMISTRY

MSCH 1103

L	T	P	Cr
4	1	0	5

Programme Outcome

PO1: Understand key concepts in Organic, Inorganic, Physical, and Analytical chemistry and describe how these principles are applied.

PO2: Apply chemical knowledge and laboratory techniques to solve problems in both academics and research.

PO3: Analyze experimental data to identify trends, interpret results, and draw logical conclusions.

PO4: Evaluate scientific literature, research findings, and chemical processes to assess their validity, reliability, and potential impact on the field.

PO5: Synthesize information from various sources to design new experiments, develop innovative solutions, and contribute to the advancement of Chemistry

PO6: Conduct advanced experiments and research projects with precision, record data accurately, and present their findings clearly to contribute to scientific knowledge.

Course Outcome

CO1: Understand key concepts in chemical bonding and molecular interactions, and explain their influence on the behaviour of organic molecules.

CO2: Apply knowledge of molecular structures to analyse chemical systems and justify the relevance of different models and rules.

CO3: Analyse molecular properties to assess the effects of structural features on chemical behaviour and reactivity.

CO4: Evaluate reaction mechanisms

and the factors influencing chemical reactions to determine their impact.

CO5: Synthesize principles of chemical reactions and symmetry to predict and explain reaction outcomes.

Course Objective

The course aims to develop students' understanding of key organic chemistry concepts, including bonding, stereochemistry, and reaction mechanisms. Students will apply theory to solve complex problems, synthesize reaction pathways, and evaluate experimental results. By course end, they will demonstrate proficiency in organic chemistry and critical thinking for advanced study.

Syllabus:

Unit	Content	No. of hours	No. of week
I	**Nature of Bonding in Organic molecules:** Delocalized Chemical Bonding — Conjugation, cross conjugation, resonance, hyper-conjugation.	10	1-3
II	**Aromaticity in Benzenoid and non-Benzenoid compounds:** Alternate and non-alternant hydrocarbons, Antiaromaticity, homo- aromaticity, Huckle rule	10	3-6
III	**Stereo chemistry** Elements of symmetry, chirality-molecules with more than one chiral center, Enantiotropic and dia-sterotopic synthesis, Optical activity in the absence of chiral carbon atom such as biphenylcs, allenes, spiranes and helical phenanthrene.	10	6-9
IV	**Reaction mechanism:** Types of reactions. Hammond's postulate, Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbine, Effect of structure on	10	9-12

	reactivity, resonance and field effect and steric effect, The Hammet equation and linear free energy relationship substituent and reaction constants.		
V	**Aromatic Electrophilic Substitution** Orientation and reactivity 'n mono substituted benzene ring, o/p ratio, orientation in other ring systems, lpso substitution, Addition to C=O:Wittig Reaction, Aldol Condensation, Perkin reaction and Benzoin condensation	10	12-15

Reference Text Books

- Bhal, S. and Tuli, R. - Textbook of Advanced Organic Chemistry (Latest Edition)
- William Kemp - Organic Spectroscopy (Latest Edition)
- Norman, R.O.C. and Coxon, J.M. - Principles of Organic Synthesis (Latest Edition)
- Peter Sykes - Mechanism in Organic Chemistry (Latest Edition)
- P.S. Kalsi - Stereochemistry: Conformation and Mechanism (Latest Edition)
- Carey, F.A. and Sundberg, R.J. - Advanced Organic Chemistry (Latest Edition)
- O.P. Agarwal - Reaction Mechanism (Latest Edition)

Reference Links

- http://www.sydney.edu.au/science/our-research/school-of-chemistry.html
- https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/

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Practical -I

MSCH 1104

L	T	P	Cr
0	0	10	5

Program Outcome

PO1: Understand key concepts in Organic, Inorganic, Physical, and Analytical chemistry and describe how these principles are applied.

PO2: Apply chemical knowledge and laboratory techniques to solve problems in both academics and research.

PO3: Analyze experimental data to identify trends, interpret results, and draw logical conclusions.

PO4: Evaluate scientific literature, research findings, and chemical processes to assess their validity, reliability, and potential impact on the field.

PO5: Synthesize information from various sources to design new experiments, develop innovative solutions, and contribute to the advancement of Chemistry

PO6: Conduct advanced experiments and research projects with precision, record data accurately, and present their findings clearly to contribute to scientific knowledge.

Course Outcome

CO1: Comprehend the principles of calorimetry and its application in determining the heat of neutralization for strong acid-base reactions.

CO2: Apply techniques to accurately measure and interpret dissociation constants of weak acids, enhancing understanding of acid-base equilibria.

CO3: Analyze experimental data to evaluate the effectiveness of EDTA methods in estimating the concentrations of Mg and Ca ions.

CO4: Evaluate the precision and accuracy of quantitative analysis methods used for cation determination, ensuring the reliability of experimental results.

CO5: Synthesize practical skills and theoretical knowledge to design and execute advanced experiments that integrate calorimetry and quantitative analysis for complex chemical systems.

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Course Objective

Practical Application: Provide students with hands-on experience in essential chemical laboratory techniques, reinforcing theoretical knowledge from lectures.

Skill Enhancement: Develop students' ability to perform advanced experimental techniques and enhance their proficiency in chemical research and analysis.

Train students in the identification, quantification, and characterization of chemical compounds through techniques such as chromatography, and titration.

Experimental Design and Execution: Equip students with the skills to design, execute, and evaluate experiments, ensuring accuracy in data collection and analysis.

Laboratory Techniques: Cultivate expertise in essential laboratory practices such as synthesis, separation, purification, and instrumental analysis, preparing students for complex research challenges.

Syllabus:

Unit	Content	No. of hours	No. of week
I	Estimation of hardness, Mg, Ca, alkalinity and chloride in water and soil.	8	1-2
II	Estimation of DO, BOD, COD	8	2-4
III	Detection and Estimation of Phosphate, nitrates and nitrites	8	4-6
IV	Detection and Estimation of Phosphate, nitrates and nitrites	8	6-8
V	Determination of pH of soil and water	8	8-10
VI	Estimation of Glucose	8	10-12
Revision Week			12-14

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Reference Text Books:

- Vogel, A.I. - Vogel's Textbook of Quantitative Chemical Analysis (Latest Edition)
- Svehla, G. - Vogel's Qualitative Chemical Analysis (Latest Edition)
- Gabriel, S. - Practical Organic Chemistry (Latest Edition)
- Willard, H.H., Merritt, L.L., and Dean, J.A. - Instrumental Methods of Analysis (Latest Edition)

Reference Link

- https://www.educationcorner.com/chemistry-experiments/
- https://www.sciencebuddies.org/science-experiments/chemistry
- https://phet.colorado.edu/

SEMESTER II

PHYSICAL CHEMISTRY II

MSCH 1201

L	T	P	Cr
4	1	0	5

Programme Outcome

PO1: Understand key concepts in Organic, Inorganic, Physical, and Analytical chemistry and describe how these principles are applied.

PO2: Apply chemical knowledge and laboratory techniques to solve problems in both academics and research.

PO3: Analyze experimental data to identify trends, interpret results, and draw logical conclusions.

PO4: Evaluate scientific literature, research findings, and chemical processes to assess their validity, reliability, and potential impact on the field.

PO5: Synthesize information from various sources to design new experiments, develop innovative solutions, and contribute to the advancement of Chemistry

PO6: Conduct advanced experiments and research projects with precision, record data accurately, and present their findings clearly to contribute to scientific knowledge.

Course outcome

CO1: Understand the basic principles of solid-state chemistry, focusing on crystal structures and defects in materials.

CO2: Analyze and differentiate between various types of defects in solids, including vacancies and other structural irregularities.

CO3: Apply quantum mechanics concepts to interpret energy levels and molecular behavior in different types of spectroscopies.

CO4: Solve fundamental problems in quantum systems using appropriate mathematical methods, including differential equations and recursion techniques.

Course objective

The course aims to understand and apply key concepts in solid-state chemistry, non-

equilibrium thermodynamics, quantum mechanics, and exactly soluble systems. Students will analyze crystal defects, entropy production, and quantum mechanics principles, and solve complex problems using these concepts. The course will also evaluate and apply approximate methods to real-world chemical systems, enhancing students' problem-solving skills and theoretical knowledge in these areas.

Syllabus:

Units	Content	No. of hours	No. of week
I	Solid state chemistry: Perfect and imperfect crystals, intrinsic and extrinsic defects, Vacancies-Schottky and Frenkel defect, non-stoichiometric defects	10	1-3
II	**Non-Equilibrium thermodynamics** Entropy production in irreversible process, Reverse osmosis and electrokinetic phenomena	10	3-5
III	**Introduction of quantum mechanics** Particle in three-dimensional box, Hermitian operators, Angular momentum operator, their Eigen function and Eigen values, Theorems of operators	10	5-8
IV	**Exactly Soluble System:** Linear Harmonic oscillator, Hermit differential equation and its solution through recursion relation-like atoms and Legendre polynomial equation and their solution. .	10	8-11
V	**Approximate Method:** Linear application to Harmonic oscillator, First order perturbation Application to He-atom, Huckel theory of conjugated system, bond order and charge density-its calculation. Application to ethylene and butadiene	10	11-14
Revision Week			15

Reference Text Books:

- R.C. Mukherjee- Modern Approach to Physical Chemistry (Latest Edition)
- S. Glasstone- Electrochemistry, Thermodynamics, and Chemical Kinetics (Latest Edition)
- Gurdeep Raj & Dr. Harish Kumar - Physical Chemistry (Latest Edition)
- V.K. Gupta & R.G. Sharma - Physical Chemistry (Latest Edition)

Reference Links:

- https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/
- https://ocw.mit.edu/courses/chemistry/5-09-organic-chemistry-spring-2008
- https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/

INORGANIC CHEMISTRY- II

MSCH 1202

L	T	P	Cr
4	1	0	5

Programme Outcome

PO1: Understand key concepts in Organic, Inorganic, Physical, and Analytical chemistry and describe how these principles are applied.

PO2: Apply chemical knowledge and laboratory techniques to solve problems in both academics and research.

PO3: Analyze experimental data to identify trends, interpret results, and draw logical conclusions.

PO4: Evaluate scientific literature, research findings, and chemical processes to assess their validity, reliability, and potential impact on the field.

PO5: Synthesize information from various sources to design new experiments, develop innovative solutions, and contribute to the advancement of Chemistry.

PO6: Conduct advanced experiments and research projects with precision, record data accurately, and present their findings clearly to contribute to scientific knowledge.

Course Outcome

CO1: Understand the essential concepts of symmetry and group theory, including symmetry elements and operations in chemistry.

CO2: Define fundamental terms related to groups and their properties, such as sub-groups and classes, within the framework of symmetry.

CO3: Construct and evaluate multiplication tables for specific point groups, showcasing the ability to apply group theory principles.

CO4: Calculate and synthesize key parameters related to transition metal complexes, understanding their impact on spectroscopic analysis.

CO5: Represent the group theory concepts using matrices to analyze the symmetry properties of molecules.

Course Objective

This course aims to provide students with a comprehensive understanding of symmetry and group theory in chemistry, enabling them to identify and analyze symmetry elements and operations. Students will learn to define and apply key group theory concepts, construct and evaluate point group multiplication tables, and calculate parameters relevant to transition metal complexes. Additionally, the course will equip students with the skills to represent and utilize group theory through matrices, enhancing their ability to analyze the symmetry proper.

Syllabus:

Unit	Content	No. of hours	No. of weeks
I	**Symmetry and Group Theory in chemistry:** Symmetry elements and symmetry operations, Definition of groups, sub-group, conjugate and class. Multiplication table for C_{2V},C_{3V}, Representation of group by matrices, Working out representation of C_{2V},C_{3V} point groups	10	1-4
II	**Electronic spectra and magnetic properties of transition metal complexes:** Derivation of spectroscopic ground states, Basic idea & calculation of D_q, B and β parameters, Spectroscopic method for assignment of absolute configuration in optically active metal chelates	10	4-8
III	**Metal clusters** Structural aspects of Boranes and other analogous elements present in its series.	10	8-11
Revision Week			12-13

Reference Text Books:

- Langford, C.H., Shriver, D.F., & Atkins, P. . Inorganic Chemistry.
- Lee, J.D. (Latest Edition). Concise Inorganic Chemistry*.
- Singh, A. . Textbook of Inorganic Chemistry*.
- Chhatwal, G.R. . Advanced Inorganic Chemistry (Part I & Part II).
- Prasad, R.K. . Quantum Chemistry
- Sekhar Rao, K.S., & Vani, K.N.K. . Textbook of Co-ordination Chemistry. Kalyani Publishers.

Reference Links

- https://onlinecourses.nptel.ac.in/noc24_cy55/preview
- https://ocw.mit.edu/courses/chemistry/5-09-organic-chemistry-spring-2008

ORGANIC CHEMISTRY -II

MSCH 1203

L	T	P	Cr
4	1	0	5

Programme Outcome

PO1: Understand key concepts in Organic, Inorganic, Physical, and Analytical chemistry and describe how these principles are applied.

PO2: Apply chemical knowledge and laboratory techniques to solve problems in both academics and research.

PO3: Analyze experimental data to identify trends, interpret results, and draw logical conclusions.

PO4: Evaluate scientific literature, research findings, and chemical processes to assess their validity, reliability, and potential impact on the field.

PO5: Synthesize information from various sources to design new experiments, develop innovative solutions, and contribute to the advancement of Chemistry

PO6: Conduct advanced experiments and research projects with precision, record data accurately, and present their findings clearly to contribute to scientific knowledge.

Course outcome

CO1: Understand the fundamental principles of organic chemistry.

CO2: Apply theoretical knowledge to know the basic concept of Organic Chemistry.

CO3: Analyze spectroscopic data, including IR, NMR, and mass spectra, to elucidate the structure of various biomolecules.

CO4: Evaluate the impact of structural variations on the reactivity and function of biomolecules in biological systems.

CO5: Create novel solutions to practical problems related to biomolecular structure, function, and reactivity by integrating theoretical concepts with experimental findings.

Course Objective

This course aims to develop a comprehensive understanding of organic chemistry, focusing on biomolecules and their roles in biological systems. Students will explore the structure,

properties, and functions of key biomolecules, apply analytical techniques to elucidate their structures, and evaluate their reactivity and function. The course will culminate in the synthesis of innovative solutions to complex biomolecular problems, integrating theoretical knowledge with practical applications.

Syllabus

Unit	Content	No. of hours	No. of weeks
I	**Carbohydrate** Conformation of monosaccharide's and important derivatives of monosaccharide–glycosides, Disaccharides - Structure determination and chemical synthesis of sucrose, maltose & lactose	10	1-3
II	**Lipids** Lipid metabolism, β-oxidation of fatty acid	10	4-5
III	**Amino acids, peptides and** Chemical and enzymatic hydrolysis of proteins, Amino acid sequencing, Secondary structure of protein, Tertiary structure of proteins folding.	10	5-8
IV	**Nucleotides and nucleic acids** Chemical properties of pyrimidine and Purine derivatives, Structure of RNA and DNA, Chemical and enzymatic hydrolysis of nucleic acid.	10	8-11
V	**Terpenoids** Introduction, classification, isoprene rule and special isoprene rule, Structural determination of citral, α-Terpeniol and camphor.	10	11-13
VI	**Alkaloids** Introduction, classification general method of structure, Structure and synthesis of the following compounds- Nicotine, Atropine	10	13-15

Reference Text Books:

- Bhal, B.S., & Tuli, A. (1996). Textbook of Advanced Organic Chemistry.
- Kemp, W. (1991). Organic Spectroscopy.
- Norman, R.O.C., & Coxon, J.M. (1993). Principles of Organic Synthesis.
- Sykes, P. (1986). Mechanism in Organic Chemistry.
- Kalsi, P.S. (2007). Stereochemistry: Conformation and Mechanism.

Reference Links

- https://ocw.mit.edu/courses/5-43-advanced-organic-chemistry-spring-2007/
- https://ocw.mit.edu/courses/chemistry/5-09-organic-chemistry-spring-2008
- https://ocw.mit.edu/courses/chemistry/5-09-organic-chemistry-spring-2009

PRACTICAL II
MSCH 1204-P

L	T	P	Cr
0	0	10	5

Program Outcome

PO1: Understand key concepts in Organic, Inorganic, Physical, and Analytical chemistry and describe how these principles are applied.

PO2: Apply chemical knowledge and laboratory techniques to solve problems in both academics and research.

PO3: Analyze experimental data to identify trends, interpret results, and draw logical conclusions.

PO4: Evaluate scientific literature, research findings, and chemical processes to assess their validity, reliability, and potential impact on the field.

PO5: Synthesize information from various sources to design new experiments, develop innovative solutions, and contribute to the advancement of Chemistry

PO6: Conduct advanced experiments and research projects with precision, record data accurately, and present their findings clearly to contribute to scientific knowledge.

Course Objective

CO1: Comprehend the principles of calorimetry and its application in determining the heat of neutralization for strong acid-base reactions.

CO2: Apply techniques to accurately measure and interpret dissociation constants of weak acids.

CO3: Analyze experimental data to evaluate the effectiveness of EDTA methods in estimating the concentrations of Mg and Ca ions.

CO4: Evaluate the precision and accuracy of quantitative analysis methods used for cation determination, ensuring the reliability of experimental results.

CO5: Synthesize practical skills and theoretical knowledge to design and execute advanced experiments that integrate calorimetry and quantitative analysis for complex chemical systems.

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Course objective

Practical Application: Provide students with hands-on experience in essential chemical laboratory techniques, reinforcing theoretical knowledge from lectures.

Skill Enhancement: Develop students' ability to perform advanced experimental techniques and enhance their proficiency in chemical research and analysis.

Experimental Design and Execution: Equip students with the skills to design, execute, and evaluate experiments, ensuring accuracy in data collection and analysis.

Laboratory Techniques: Cultivate expertise in essential laboratory practices such as synthesis, separation, purification, and instrumental analysis, preparing students for complex research challenges

Syllabus:

Unit	Content	No. of hours	No. of week
I	Estimation of hardness, Mg, Ca, alkalinity and chloride in water and soil.	8	1-2
II	Estimation of DO, BOD, COD	8	2-4
III	Detection and Estimation of Phosphate, nitrates and nitrites	8	4-6
IV	Detection and Estimation of Phosphate, nitrates and nitrites	8	6-8
V	Determination of pH of soil and water	8	8-10
VI	Estimation of Glucose	8	10-12

Reference Text Books;

- Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
- . Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.;McGraw-Hill: New York (2003).
- 3 Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman &Co.: New York (2003)
- Vogel's Textbook of Quantitative Chemical Analysis" by G. H. Jeffery, J. Bassett, J. Mendham, and R.C. Denney

Reference Link

- https://www.educationcorner.com/chemistry-experiments/
- https://www.sciencebuddies.org/science-experiments/chemistry
- https://phet.colorado.edu/

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SEMESTER III

SPECTROSCOPY-II

MSCH 2102

L	T	P	Cr
0	0	10	5

Program Outcome

PO1: Understand key concepts in Organic, Inorganic, Physical, and Analytical chemistry and describe how these principles are applied.

PO2: Apply chemical knowledge and laboratory techniques to solve problems in both academics and research.

PO3: Analyze experimental data to identify trends, interpret results, and draw logical conclusions.

PO4: Evaluate scientific literature, research findings, and chemical processes to assess their validity, reliability, and potential impact on the field.

PO5: Synthesize information from various sources to design new experiments, develop innovative solutions, and contribute to the advancement of Chemistry

PO6: Conduct advanced experiments and research projects with precision, record data accurately, and present their findings clearly to contribute to scientific knowledge.

Course outcome

CO1: Understand the foundational principles of various spectroscopic methods.

CO2: Apply these spectroscopic techniques to accurately determine molecular characteristics such as bond lengths, vibrational frequencies, and chemical shifts.

CO3: Analyze spectral data using principles of quantum mechanics.

CO4: Evaluate spectroscopic data critically by considering instrument limitations, experimental conditions.

CO5: Synthesize ethical practices in the collection, analysis, and reporting of spectroscopic data, demonstrating integrity and responsibility in scientific research.

Course objective

The course objective is to equip students with a thorough understanding of various spectroscopic methods, enabling them to apply these techniques to analyze molecular structures and properties. Students will develop the ability to interpret spectral data using quantum mechanical principles, critically evaluate the impact of experimental conditions, and uphold ethical standards in data handling and reporting.

Syllabus

Unit	Content	No. of hours	No. of week
I	**Rotational spectra:** Classification of molecules, Rigid rotator model, Non-rigid rotator, Quantization of rotational energy level, Bond Length calculation.	10	1-3
II	**Vibrational rotational spectra:** Quantization of vibrational energy level, vibrational energy of diatomic molecule, Anharmonicity, Group frequency, Finger print region, Factors influencing vibrational frequency.	10	3-6
III	**NMR Spectroscopy:** Nuclear spin, nuclear resonance, shielding of magnetic nuclei, Factor influencing chemical dishelming and coupling constant	10	6-9
IV	**Mass Spectroscopy:** Ion production, ion analysis, factors affecting fragmentation, Mass spectral fragmentation of Organic compounds	10	9-12
V	**Various electronic transitions** Beer Lambert Law, effect of solvent on electronic transition Fieser Wooward rules for calculating λ_{max} in conjugated dienes & α, β-unsaturated carbonyl compounds. H_2 molecule, Ground & excited state terms derivation of H_2 molecule. ^{13}C NMR, spin decoupling, Shift reagent	10	12-15

Reference Text Books:

- Introduction to Spectroscopy" by Donald L. Pavia, Gary M. Lampman, and George S. Kriz (5th Edition, 2014)
- Spectroscopy of Organic Compounds" by P.S. Kalsi (7th Edition, 2020)
- Molecular Spectroscopy: Modern Research" edited by J. Michael Hollas (4th Edition, 2020)

Reference Links

- https://www.rsc.org/periodic-table/chemistry-terms/spectroscopy
- https://www.spectroscopy.illinois.edu/

ENVIRONMENTAL AND ANALYTICAL CHEMISTRY

MSCH 2101

L	T	P	Cr
0	0	10	5

Programme Outcome

PO1: Understand key concepts in Organic, Inorganic, Physical, and Analytical chemistry and describe how these principles are applied.

PO2: Apply chemical knowledge and laboratory techniques to solve problems in both academics and research.

PO3: Analyze experimental data to identify trends, interpret results, and draw logical conclusions.

PO4: Evaluate scientific literature, research findings, and chemical processes to assess their validity, reliability, and potential impact on the field.

PO5: Synthesize information from various sources to design new experiments, develop innovative solutions, and contribute to the advancement of Chemistry

PO6: Conduct advanced experiments and research projects with precision, record data accurately, and present their findings clearly to contribute to scientific knowledge.

Course Outcome

CO1: Understand the roles and importance of metals and trace elements in biological systems and their impact on biochemical processes.

CO2: Apply concepts of protein structure and function to elucidate the roles of essential proteins like myoglobin and haemoglobin in biological systems.

CO3: Analyse the mechanisms and functions of redox systems, including cytochromes, iron-sulphur proteins, and biological nitrogen fixation, within the context of cellular processes.

CO4: Evaluate the principles of ATP synthesis and hydrolysis, along with the thermodynamic aspects of biological processes.

CO5: Synthesize information on key carbohydrate metabolism pathways and their interactions.

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Course Objective

This course aims to provide students with a thorough understanding of the roles and significance of metals and trace elements in biological systems. The course will focus on analyzing redox mechanisms, including cytochromes and iron-sulfur proteins, within cellular processes. Additionally, students will evaluate the principles of ATP synthesis and hydrolysis, considering their thermodynamic aspects, and synthesize information on carbohydrate metabolism pathways to understand their interactions and significance in biological systems.

Syllabus:

Unit	Content	No. of hours	No. of week
I	**Environment & hydrosphere** Composition of atmosphere, Biogeochemical cycles of C, N, P, S and N chemical composition of water bodies, Hydrological cycle, Water quality parameters-dissolved oxygen, BOD, solids, metals, contents of chloride, sulfate, phosphate, nitrate and microorganisms, Analytical methods for measuring BOD, DO, COD, F, chloride and chlorine demand.	10	1-3
II	**Soils and Industrial pollution** Composition of soils, micro and macro nutrients, Soil pollution-fertilizers, pesticides, Industrial pollution	10	3-5
III	**Atmosphere:** Particles, ions and radicals in atmosphere, their formation, Chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, O and their effect,Green house effect, Acid rains.	10	5-7
IV	**Analytical chemistry:** Analytical methods for measuring air and water pollutants, Instrumental techniques for analysis of heavy metal in aqueous systems.	10	7-10
V	**Thermal Analysis and Calorimetry:** Basic principles of thermal analysis, TG, DTA, DSC, TM and microcalorimetry, Applications in polymer chemistry and solid-state reactions	10	10-12
VI	**Chromatography and colorimetry:**	10	12-15

	Chromatography-Classification, chromatograph terminology, Colorimetry:- Beer Lambert law, Photoelectric colorimeter		

Reference Text Books:

- Langford, H. L., Shriver, D. F., & Atkins, P. (Latest Edition). Inorganic Chemistry. Oxford University Press.
- Lee, J. D. (Latest Edition). Concise Inorganic Chemistry. Wiley.
- Singh, A. (Latest Edition). Textbook of Inorganic Chemistry. (Publisher details needed). Typically published by a regional or national publisher.

Reference Link

- https://www.coursera.org/learn/environmental-chemistry
- https://www.epa.gov/chemical-research/environmental-chemistry\

BIO-INORGANIC CHEMISTRY AND BIO-ORGANIC CHEMISTRY

Sub Code-MSCH 2103

L	T	P	Cr
0	0	10	5

Program Outcome

PO1: Understand key concepts in Organic, Inorganic, Physical, and Analytical chemistry and describe how these principles are applied.

PO2: Apply chemical knowledge and laboratory techniques to solve problems in both academics and research.

PO3: Analyze experimental data to identify trends, interpret results, and draw logical conclusions.

PO4: Evaluate scientific literature, research findings, and chemical processes to assess their validity, reliability, and potential impact on the field.

PO5: Synthesize information from various sources to design new experiments, develop innovative solutions, and contribute to the advancement of Chemistry

PO6: Conduct advanced experiments and research projects with precision, record data accurately, and present their findings clearly to contribute to scientific knowledge.

Course Outcome

CO1: Understand the interconnectedness of environmental systems and their impact on global environmental health.

CO2: Apply analytical methods to assess water quality parameters, soil composition, and air pollutants.

CO3: Analyze the role of trace elements and metal complexes in biological systems.

CO4: Evaluate the impact of atmospheric pollutants and biochemical processes on environmental and biological systems.

CO5: Synthesize knowledge of biochemical pathways, including carbohydrate metabolism, protein synthesis, and bioenergetics.

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Course Objective

The course objective is to provide students with a comprehensive understanding of environmental systems and their interactions, enabling them to apply analytical methods to evaluate water, soil, and air quality. Students will analyze the role of metals and trace elements in biological systems and evaluate the effects of pollutants on environmental and health

systems. Finally, students will synthesize biochemical pathways to gain insights into cellular processes and genetic functions

Syllabus:

Unit	Content	No. of hours	No. of week
I	**Metals in biological systems:** Trace elements and their significance. Na^+/K^+ pump, Transport and storage proteins, Structure and functioning of myoglobin & hemoglobin, Metal complexes in transmission of energy, chlorophylls, Photo system-I and photo system-ll in cleavage of water.	10	1-3
II	**Electron transfer and Redox systems:** Cytochromes and iron-sulfur proteins, biological nitrogen fixation. nitrogenase. Cell membrane: Ion transport through cell membrane	10	3-6
IV	**Enzymes properties** Specify orientation and steric effects-coenzymes. Idea of prosthetic groups, thiamine, pyrophosphate, NADP, NADO, FMN&FAD.	10	6-9
V	**Bioenergetics:** Synthesis of ATP, Hydrolysis of ATP and entropy change in biological process.Carbohydrate MetabolismCalvin cycle, Kreb cycle, Glycolysis, glucogenesis, glycogenolysis Biosynthesis of disaccharides	10	9-12

VI	**Protein synthesis:** Chemical basis of heredity, Replication of DNA, The effect of x-rays and y -rays on nucleic acid and protein structure.	10	12-15

Reference Text Books

- Mukherjee, R. C. (2000). Modern Approach to Physical Chemistry. Thomson Press India.
- Glassstone, S. (1979). Electrochemistry, Thermodynamics, Chemical Kinetics. Pergamon Press.
- Gurdeep, & Harish, Dr. (2010). Physical Chemistry. Krishna Prakashan Media.
- Gupta, V. K., & Sharma, R. G. (2017). Physical Chemistry. Shoban Lal Nagi & C

Reference Link

- https://onlinecourses.swayam2.ac.in/cec24_bt16/preview
- https://onlinecourses.nptel.ac.in/noc21_cy18/preview

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PRACTICAL – III

MSCH 2104-P

L	T	P	Cr
0	0	10	5

Program Outcome

PO1: Understand key concepts in Organic, Inorganic, Physical, and Analytical chemistry and describe how these principles are applied.

PO2: Apply chemical knowledge and laboratory techniques to solve problems in both academics and research.

PO3: Analyze experimental data to identify trends, interpret results, and draw logical conclusions.

PO4: Evaluate scientific literature, research findings, and chemical processes to assess their validity, reliability, and potential impact on the field.

PO5: Synthesize information from various sources to design new experiments, develop innovative solutions, and contribute to the advancement of Chemistry

PO6: Conduct advanced experiments and research projects with precision, record data accurately, and present their findings clearly to contribute to scientific knowledge.

Course Outcome

CO1: Understand the principles and techniques involved in conducting experimental procedures for determining distribution coefficients, reaction kinetics, and acid-base equilibria.

CO2: Apply experimental methods to accurately determine distribution coefficients, reaction kinetics, and acid-base equilibria.

CO3: Analyze experimental data to draw meaningful conclusions about underlying chemical principles and phenomena.0

CO4: Evaluate practical laboratory skills by assessing measurement techniques, chemical handling, equipment usage, and adherence to safety protocols.

CO5: Synthesize knowledge and skills by synthesizing aspirin from salicylic acid, demonstrating competence in organic

synthesis techniques.

Course Objective

Practical Application: Provide students with hands-on experience in essential chemical laboratory techniques, reinforcing theoretical knowledge from lectures.

Skill Enhancement: Develop students' ability to perform advanced experimental techniques and enhance their proficiency in chemical research and analysis.

Train students in the identification, quantification, and characterization of chemical compounds through techniques such as chromatography, and titration.

Experimental Design and Execution: Equip students with the skills to design, execute, and evaluate experiments, ensuring accuracy in data collection and analysis.

Laboratory Techniques: Cultivate expertise in essential laboratory practices such as synthesis, separation, purification, and instrumental analysis, preparing students for complex research challenges.

Syllabus:

Unit	Content	No. of hours	No. of week
I	Determination of the distribution coefficient of I_2, between $CCl_4$and water.	8	1-3
II	Determination of the velocity constant of hydrolysis (saponification) of ethyl acetate with NaOH.	8	3-6
III	Determination of the order of reaction and the energy of activation of the reaction between H,O, and HI.	8	6-9
IV	Determination of basicity of succinic acid conductometrically.	8	9-12
V	Synthesis of Aspirin from Salicylic Acid	8	12-15

Reference Text Books:

- Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.:New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.;McGraw-Hill: New York (2003).
- 3 Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman &Co.: New York (2003)

Reference Link

- https://www.educationcorner.com/chemistry-experiments/
- https://www.sciencebuddies.org/science-experiments/chemistry
- https://phet.colorado.edu/

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SEMESTER IV

MEDICINAL CHEMISTRY (ORGANIC SPECIAL)

MSCH 2203

L	T	P	Cr
4	1	0	5

Programme Outcome

PO1: Understand key concepts in Organic, Inorganic, Physical, and Analytical chemistry and describe how these principles are applied.

PO2: Apply chemical knowledge and laboratory techniques to solve problems in both academics and research.

PO3: Analyze experimental data to identify trends, interpret results, and draw logical conclusions.

PO4: Evaluate scientific literature, research findings, and chemical processes to assess their validity, reliability, and potential impact on the field.

PO5: Synthesize information from various sources to design new experiments, develop innovative solutions, and contribute to the advancement of Chemistry

PO6: Conduct advanced experiments and research projects with precision, record data accurately, and present their findings clearly to contribute to scientific knowledge.

Course Outcome

CO1: Understand the overarching principles of drug design.

CO2: Apply general theories of drug activity to evaluate the mechanisms and therapeutic potential of different drug classes.

CO3: Analyze the role of chemical synthesis in drug development.

CO4: Evaluate the impact of various drug types on disease management.

CO5: Synthesize information from diverse drug classes to form a cohesive.

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Course Objective

The course objective is to provide students with a comprehensive understanding of drug design principles and their application across various drug classes. Students will develop the ability to analyze and evaluate drug synthesis, effectiveness, and therapeutic roles.

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Syllabus:

Unit	Content	No. of hours	No. of week
I	**Drug Design:** Introduction, classification, SAR factor affecting bio activity, Theories of drug activity	10	1-3
II	**Antineoplastic agents**:(a) Cancer chemotherapy (b)Synthesis of Uracil	10	3-5
III	**Cardiovascular Drugs:** Cardiovascular disease,Synthesis of amyl nitrate, sorbitrate.juinidine, Methyldopa, atenolol and oxyprenolol	10	5-8
IV	**Anti-tubercular Drugs**: a)PAS, Isoniazid **Antiparkinsonian Drugs**: (a)Introduction, levodopa and some ther dopaminergic agents — Anticholingeric, Aminoalcohols (b) Ethers-A phenothiazine derivations. Drugs based on five membered heterocycles	10	8-11

Reference Text Books

- Bhal, N. S., & Tuli, G. D. (Latest Edition). Textbook of Advanced Organic Chemistry. S. Chand & Company Ltd.
- Kemp, W. (Latest Edition). Organic Spectroscopy. Palgrave Macmillan.
- Norman, R. O. C., & Coxon, J. M. (Latest Edition). Principles of Organic Synthesis. CRC Press.
- Sykes, P. (Latest Edition). Mechanism in Organic Chemistry. Pearson.
- Kalsi, P. S. (Latest Edition). Stereochemistry: Conformation and Mechanism. New Age International Publishers.

Reference Links

- https://www.rsc.org/periodic-table/chemistry-terms/medicinal-chemistry
- https://www.nature.com/nrd/
- https://ocw.mit.edu/courses/chemistry/5-111-principles-of-chemical-science-fall-2008/

NATURAL PRODUCTS (ORGANIC SPECIAL)

MSCH 2202

L	T	P	Cr
4	1	0	5

Programme Outcome

PO1: Understand key concepts in Organic, Inorganic, Physical, and Analytical chemistry and describe how these principles are applied.

PO2: Apply chemical knowledge and laboratory techniques to solve problems in both academics and research.

PO3: Analyze experimental data to identify trends, interpret results, and draw logical conclusions.

PO4: Evaluate scientific literature, research findings, and chemical processes to assess their validity, reliability, and potential impact on the field.

PO5: Synthesize information from various sources to design new experiments, develop innovative solutions, and contribute to the advancement of Chemistry.

PO6: Conduct advanced experiments and research projects with precision, record data accurately, and present their findings clearly to contribute to scientific knowledge.

Course Outcome

CO1: Understand the overall methodologies used for isolating and characterizing natural products.

CO2: Apply fundamental concepts of biosynthesis to gain insights into the production and significance of a range of natural compounds.

CO3: Evaluate the general importance and biological roles of key vitamins and natural products.

CO4: Analyze laboratory techniques for studying natural products, focusing on their effectiveness.

CO5: Develop comprehensive skills in laboratory practices for natural product analysis, integrating theoretical knowledge with

practical techniques.

Course objective

The course objective is to provide students with a comprehensive understanding of techniques for isolating and characterizing natural products. Students will apply biosynthesis concepts to study natural compounds, evaluate their biological roles, analyze laboratory methods, and develop practical skills in natural product analysis, integrating theoretical and practical knowledge.

Syllabus:

Unit	Content	No. of hours	No. of week
I	I Alkaloids: Occurrence, Isolation, structural determination, stereochemistry and synthesis, Ephedrine, Quinine, Morphine and Narcotine.	10	1-3
II	Steroids and Hormones : Introduction, structural determination and synthesis of cholesterol, Androsterone, Cortisone (only synthesis)	10	3-6
III	Vitamins : Occurrence, Classification, biological functions Structure determination and synthesis of vitamins Vit A, ,Vit B and Vit C.	10	6-9
IV	Plant pigments: Occurrence, structural determination and thesis of flavones, Isoflavone, anthocyanins, jocyanidines and coumarins	10	9-12
Revision Week			13-14

Reference Text Books:

- Bhal, N. S., & Tuli, G. D. (Latest Edition). Textbook of Advanced Organic Chemistry. S. Chand & Company Ltd.
- Kemp, W. (Latest Edition). Organic Spectroscopy. Palgrave Macmillan.
- Norman, R. O. C., & Coxon, J. M. (Latest Edition). Principles of Organic Synthesis. CRC Press.

Reference Links:

- https://pubchem.ncbi.nlm.nih.gov/
- https://www.nature.com/nchem/
- https://webbook.nist.gov/chemistry/

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HETEROCYCLIC CHEMISTRY (ORGANIC SPECIAL)

Sub Code-MSCH 2203

L	T	P	Cr
4	1	0	5

Programme Outcome

PO1: Understand key concepts in Organic, Inorganic, Physical, and Analytical chemistry and describe how these principles are applied.

PO2: Apply chemical knowledge and laboratory techniques to solve problems in both academics and research.

PO3: Analyze experimental data to identify trends, interpret results, and draw logical conclusions.

PO4: Evaluate scientific literature, research findings, and chemical processes to assess their validity, reliability, and potential impact on the field.

PO5: Synthesize information from various sources to design new experiments, develop innovative solutions, and contribute to the advancement of Chemistry

PO6: Conduct advanced experiments and research projects with precision, record data accurately, and present their findings clearly to contribute to scientific knowledge.

Course Outcome

CO1: Understand the general principles behind the structures, properties, and synthesis of key biopolymers.

CO2: Explain the fundamental concepts of benzofused five-membered heterocyclic compounds.

CO3: Evaluate the broader aspects of synthesis and reactions for larger heterocycles with multiple heteroatoms.

CO4: Demonstrate advanced analytical and problem-solving skills in interpreting experimental data.

CO5: Apply theoretical and practical knowledge of biopolymers, synthetic polymers, and heterocyclic compounds

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Course objective

The course objective is to provide students with a broad understanding of biopolymer structures and synthesis, as well as the fundamental concepts of benzofused and larger heterocyclic compounds. Students will develop the ability to analyze experimental data critically, apply their knowledge to solve complex problems in organic synthesis, and integrate theoretical and practical insights into chemical applications.

Syllabus:

Unit	Content	No. of hours	No. of weeks
I	**Biopolymers:** Polysaccharides, starch, amino acids and polypeptides, Proteins	10	1-3
II	**Synthetic polymers** Polyester, polytetrafluoroethelene, polyurethanes, poly-amino acids, polycyanoacrylates	10	3-6
III	**Benzofused five membered heterocyclic compounds:** Classification, nomenclature of aromatic heterocycles, synthesis and reaction of benzopyrole, benzofuran and benzothiophenes	10	6-9
IV	**Five and six membered Heterocycles with two or more heteroatoms** Synthesis and reaction of oxazole, isooxazole thiazole, diazine and tetrazines	10	9-12
	Seven and large membered Heterocycles with two or more heteroatoms: Synthesis and reaction of azepines, oxepines, diazepines	10	12-5

Reference **Text Books**

- Bhal, N. S., & Tuli, G. D. (Latest Edition). Textbook of Advanced Organic Chemistry. S. Chand & Company Ltd.
- Kemp, W. (Latest Edition). Organic Spectroscopy. Palgrave Macmillan.
- Norman, R. O. C., & Coxon, J. M. (Latest Edition). Principles of Organic Synthesis. CRC Press.
- Sykes, P. (Latest Edition). Mechanism in Organic Chemistry. Pearson.

Reference Links

- https://www.youtube.com/watch?v=Go2Mbqd9YdM
- https://www.chemguide.co.uk/organicprops/heterocycles/intro.html
- https://www.rsc.org/periodic-table/chemistry-terms/heterocyclic-chemistry

PROJECT AND DISSERTATION

MSCH 2204-P

L	T	P	Cr
0	0	10	5

Programme Outcome

PO1: Understand key concepts in Organic, Inorganic, Physical, and Analytical chemistry and describe how these principles are applied.

PO2: Apply chemical knowledge and laboratory techniques to solve problems in both academics and research.

PO3: Analyze experimental data to identify trends, interpret results, and draw logical conclusions.

PO4: Evaluate scientific literature, research findings, and chemical processes to assess their validity, reliability, and potential impact on the field.

PO5: Synthesize information from various sources to design new experiments, develop innovative solutions, and contribute to the advancement of Chemistry

PO6: Conduct advanced experiments and research projects with precision, record data accurately, and present their findings clearly to contribute to scientific knowledge.

Course Outcome

CO1: Research Proficiency: Enable students to independently design and conduct advanced research in chemistry.

CO2: Experimental Design and Methodology: Develop students' ability to formulate research questions, design experiments, and employ appropriate methodologies for data collection and analysis.

CO3: Critical Analysis: Foster critical thinking and problem-solving skills by analyzing research findings, interpreting data, and evaluating scientific literature to draw meaningful conclusions.

CO4: Technical Mastery: Enhance proficiency in using advanced laboratory techniques and instrumentation relevant to the chosen research field.

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Course Objective

The objective of the MSc Chemistry final dissertation is to guide students in applying advanced knowledge and research skills in a specialized area of chemistry. By conducting independent research, students will analyze scientific literature, formulate relevant research questions, design and implement experimental methods, and interpret results.

Reference Link

- **www.Goooglescholar.com**
- **www.researchgate.com**
- **https://dissertationtop.com/chemistry-dissertation-topics**
