



# LEARNING COURSE OUTCOME FRAMEWORK (LCOF) CHEMISTRY UG & PG

*DEPARTMENT OF CHEMISTRY & BIOCHEMISTRY  
GOVT. M. H. COLLEGE OF HOME SCIENCE AND SCIENCE FOR WOMEN, JABALPUR  
SESSION FROM 2019 -20 TO 2023-24*



www.gmhcollege.org.in

शासकीय मो.ह.गृह विज्ञान एवं विज्ञान महिला, महाविद्यालय

GOVERNMENT M. H. COLLEGE OF HOME SCIENCE & SCIENCE FOR WOMEN

नैपियर टाउन, जबलपुर - 482002 मध्य प्रदेश, भारत

Napier Town, Jabalpur - 482002 Madhya Pradesh, India

## *Course Outcome*

### Department of Chemistry

#### B. Sc. First Year

##### MAJOR PAPER 1

##### FIRST PAPER -FUNDAMENTALS OF CHEMISTRY

<b>CO1:</b>	Ancient Indian chemical techniques.
<b>CO2:</b>	Various theories and principles applied to reveal atomic structure.
<b>CO3:</b>	Significance of quantum numbers.
<b>CO4:</b>	Concept of periodic properties of elements.
<b>CO5:</b>	Theories related to chemical bonding.
<b>CO6:</b>	Acid-base concept, pH, buffer.
<b>CO7:</b>	Factors responsible for reactivity of organic molecules.
<b>CO8:</b>	Basics and mechanism of chemical kinetics.
	Properties of electrolytes.

##### MAJOR PAPER 2/MINOR/ ELECTIVE

##### SECOND PAPER -ANALYTICAL CHEMISTRY

<b>CO1:</b>	Basic concepts of Mathematics for Chemists.
<b>CO 2.</b>	Fundamentals of analytical chemistry and steps involved in analysis.
<b>CO 3.</b>	Basic knowledge of Computer for chemists.

CO 4.	Basic Concepts of Chemical equilibrium.
CO 5.	Principles of Chromatography and chromatographic techniques.
CO 6.	Various techniques of Spectroscopic Analysis.

**GENERIC ELECTIVE**

**THIRD PAPER – CHEMISTRY IN EVERYDAY LIFE**

CO1:	Learn about the chemistry of ancient India. Ancient construction materials and discoveries.
CO2:	Gain information about acids, bases and salts involved in our day to day life.
CO3:	Have an idea of food adulteration, its harmful effects, and methods to detect adulteration and the important constituents of our food.
CO4:	Student will be familiar with the chemical nomenclature of the commonly used materials in daily life including toiletries, kitchen and beverages.
CO5:	Have an Elementary idea of disinfectants, pesticides and cleaners.

**LABORATORY COURSE: CHEMISTRY PRACTICAL –  
MAJOR (PAPER I) - QUALITATIVE & QUANTITATIVE CHEMICAL ANALYSIS  
CORE COURSE –**

By the end of this course students will learn the following aspects of laboratory exercises in chemistry:

CO1:	Importance of chemical safety and lab safety while performing experiments in laboratory
CO2:	Qualitative inorganic analysis
CO3:	Elemental analysis of organic compounds (non-instrumental)
CO4:	Qualitative identification of functional group of organic compounds
CO5:	Techniques of pH measurements
CO6:	Preparation of buffer solutions

**LABORATORY COURSE: CHEMISTRY PRACTICAL –  
MAJOR (PAPER II) ANALYTICAL PROCESSES AND TECHNIQUES CORE COURSE/  
MINOR/ ELECTIVE –**

By the end of this course students will learn the following aspects of laboratory exercises in chemistry:

CO1:	Concepts and analytical methods in Chemistry.
CO2:	Preparation of solutions of different concentrations.
CO3:	Standardization of the solution.
CO4:	Identification of Organic compounds by chromatographic techniques.
CO5:	Analysis by Spectral Techniques.

**LABORATORY COURSE: CHEMISTRY PRACTICAL –  
OPEN ELECTIVE**

**CHEMISTRY IN EVERYDAY LIFE - GENERIC ELECTIVE –**

By the end of course students will learn the following aspects of laboratory exercises in chemistry

CO1:	Concepts and analytical methods in chemistry.
CO2:	Identification of acids, bases and salts involved in our day to day life.
CO3:	Methods to detect adulteration in commonly used food materials.
CO4:	Preparation of Natural indicator.

## B. Sc. Second Year

Course  
outcome

*On completion of this course, successfully students will be able to learn:*

***Title of the paper***

### **MAJOR PAPER 1**

#### **REACTIONS, REAGENTS AND MECHANISMS IN ORGANIC CHEMISTRY (PAPER 1)**

CO1:	By the end of this course students will acquire the knowledge of following aspects of Chemistry:
CO2:	Various organic reactions, reagents and their mechanisms, which will be helpful in understanding organic synthesis.
CO3:	Application of the reactions in the various industries. like pharmaceutical, polymer, pesticides, textile, Dyes etc.
CO4:	Important key reactions used in further study and Research work.



## MAJOR PAPER 2/MINOR/ELECTIVE

### SECOND PAPER -INORGANIC CHEMISTRY

#### TRANSITION ELEMENTS, CHEMI-ENERGETICS, PHASE EQUILIBRIA (PAPER 2)

By the end of this course students will learn the following aspects of chemistry:

CO1:	Introductory idea about Traditional Indian Chemistry
CO2:	<ul style="list-style-type: none"><li>Chemistry of d- &amp; f-block Elements, Basic Concepts of Coordination Chemistry.</li></ul>
CO3:	<ul style="list-style-type: none"><li>Stereochemistry of Transition Metal Complexes.</li></ul>
CO4:	<ul style="list-style-type: none"><li>Laws of Thermodynamics.</li></ul>
CO5:	<ul style="list-style-type: none"><li>Concepts of Phase Equilibrium with reference to Solid Solution, Liquid-Liquid Mixtures, partially Miscible Liquids. Basic Concepts of Electrochemistry.</li></ul>

### GENERIC ELECTIVE -CHEMISTRY FOR FARMERS

At the end of the program student will gain knowledge of following aspects of chemistry-

CO1:	Pro cultivation crop improvement soil and crop management for sustainable organic agriculture production and development.
CO2:	Physical properties of soil and fertilizers types, Soil types and soil structure required for an agricultural field.
CO3:	Analysis and identification of complex agricultural problems and formulating ethical solutions.
CO4:	Innovative processes products and technology to meet the challenges in agriculture and farming practices.
CO5:	Fundamentals of horticulture modern farming and organic farming.

### LABORATORY COURSE:

#### CHEMISTRY PRACTICAL MAJOR PAPER 1

##### ORGANIC QUALITATIVE ANALYSIS, REACTIONS AND SYNTHESIS (PAPER 1)

CO1:	By the end of this course students will acquire the knowledge of following practical aspects of Chemistry: <ul style="list-style-type: none"><li>To perform various reactions, which will be helpful in</li></ul>
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Understanding organic synthesis.

- To use reagents to perform organic reactions.
- To perform rearrangement reactions.
- To prepare various organic compounds.
- To use chromatographic technique to monitor organic reactions.
- Applications of the reactions in the industries, e.g., pharmaceutical, polymer, pesticides, textile, dyes, etc. industries.

These experiments will also be useful in further study and research work.

## LABORATORY COURSE:

### CHEMISTRY PRACTICAL MAJOR PAPER 2/MINOR/ELECTIVE

#### METAL COMPLEX PREPARATION, THERMOCHEMICAL & PHASE EQUILIBRIA EXPERIMENTS (PAPER 2)

**CO1:** By the end of this course students will learn the following aspects of laboratory exercises of Chemistry:

- Preparation of inorganic complexes.
- Use of calorimeter for thermochemistry experiments.
- Determination of enthalpy of various system and reactions.
- Experiments on phase equilibria.
- Construction of phase diagrams.

Study of reaction equilibrium.

## B. Sc.Third Year

Course  
outcome

*On completion of this course, successfully students will be able to learn:*

***Title of the paper***

**MAJOR GROUP A**

#### GREEN AND AGRICULTURE CHEMISTRY (PAPER I)

**By the end of this course student will acquired the knowledge of following aspects of green and agriculture chemistry**

**CO1:** Basic principle of green and sustainable chemistry.

**CO2:** Understand stoichiometric calculation and relate them to green process metrics.

**CO3:** Learn alternative solvent media green catalysis and energy sources of chemical

processes.

**CO4:** Understand the requirements of manures and fertilizers for various crops and their proper time of application.

**CO5:** Understand to maintain soil fertility for better crop production.

### LABORATORY COURSE: PRACTICAL

By the end of this course student will acquired the knowledge of following aspects of green chemistry.

**CO1:** To learn green synthesis of organic and inorganic compound.

**CO2:** To learn to prepare green ionic liquids.

**CO3:** To understand soil profile sampling and study minerals present in soil.

**CO4:** To learn to estimate organic matter content of soil.

### GROUP A PAPER II (DSE- 1 PAPER 2)

#### LABORATORY SKILL, TECHNIQUES AND MANAGEMENT

At the end of course the learner will be -

**CO1:** Familiarized with the basic facilities available in laboratories  
300 to adopt appropriate disposal procedures and safety method suitable for laboratories.

**CO2:** Expected to gain knowledge of the basic skill of organisation and management of science laboratories.

**CO3:** Unable to expertise in the procedures to procurement and storage of laboratory equipment and materials.

**CO4:** Trained in the operation and maintenance of simple instruments used in Science laboratories.

**CO5:** Unable to develop skills in common laboratory techniques.

**CO6:** Trained to adopt appropriate disposal procedures and safety method suitable for laboratories.

### GROUP A PAPER II (DSE- 1 PAPER 2)

#### LABORATORY COURSE: EXERCISE FOR DEVELOPMENT OF LAB SKILLS

On completion of this course learner will able to- handle and run any chemistry lab skillfully.

Students will be able to perform general exercises like.

CO1:	Preparation of standard solution.
CO2:	Determination of concentration.
CO3:	Determination of MP pH conductivity.
CO4:	Preparation of a stock solution.
CO5:	Preparation of various reagents.

**MAJOR GROUP B**

**INSTRUMENTAL TECHNIQUES IN CHEMISTRY (PAPER I)**

By the end of the course a student will learn the following aspect of instrumental techniques in chemistry

CO1:	Preparation of standard sample for analysis.
CO2:	Instrumentation for analytical methods of chemistry.
CO3:	Instrumentation for various spectroscopic techniques.
CO4:	Principles and instrumentation of various electro analytical techniques.
CO5:	Instrumentation used in optical methods of analysis.
CO6:	Advanced chromatography technique.

**GROUP B PAPER I**

**LABORATORY COURSE: INSTRUMENTAL ANALYTICAL TECHNIQUE IN CHEMISTRY**

By the end of the course student will learn the following aspect of instrumental techniques in chemical analysis

CO1:	Preparation of standard samples for analysis.
CO2:	Determination of concentration of solution spectrometrically.
CO3:	Determination of stoichiometry and stability constant and complexes.
CO4:	Potentiometric and conductometric titrations.
CO5:	Advance chromatography techniques.

**GROUP B PAPER II**

**BIO PHYSICAL, BIO INORGANIC AND ORGANOMETALLIC CHEMISTRY (PAPER II)**

*On completion of this course the students will be able to understand*

CO1:	<i>Bio physical concepts like pHbiological oxidation bioenergetics.</i>
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CO2:	<i>Magnetic properties and electronic spectra of transition metal complexes.</i>
CO3:	<i>Structure and bonding analysis of organometallic compounds using the MOtheory.</i>
CO4:	<i>Organometallic compounds of main group elements and their structure and bonding analysis.</i>
CO5:	<i>Bio Inorganic Chemistry and role of metal ions in biological systems.</i>

## GROUP B PAPER II

### GROUP B PAPER 2 LABORATORY COURSE

#### SYNTHESIS AND ANALYTICA TECHNIQUES

***On completion of this course the students will be able to -***

CO1:	<i>How to synthesize ferrocene from ferric chloride.</i>
CO2:	<i>How to synthesis of potassium tries oxalate ferrate.</i>
CO3:	<i>How to determine pH of bio sample</i>
CO4:	<i>How to determine sugar in blood sample by photometry.</i>

## MINOR/ELECTIVE

### PHARMACEUTICAL AND MEDICINAL CHEMISTRY

***After successfully completing this course module students will be able to-***

CO1:	<i>Understand importance of pharmaceutical chemistry and pharmacopoeia.</i>
CO2:	<i>Learn intellectual property rights patents trademark and copyright.</i>
CO3:	<i>Understand definition classification of the drug with example and structures.</i>
CO4:	<i>Describe the structure activity relation of some important class of drugs.</i>
CO5:	<i>Describe the over all process of drug discovery and the role played by medicinal chemistry in this process.</i>
CO6:	<i>Relate the structure and physical properties of drugs to their pharmacological</i>

activity.

**CO7:** explain you chemical properties related to QSAR.

**LABORATORY COURSE GROUP B PAPER 2**

**PHARMACEUTICAL MEDICINAL CHEMISTRY MINOR/ ELECTIVE**

*On completion of this course the students will be able to understand*

**CO1:** How to prepare acetanilide.

**CO2:** How to isolate the caffeine from the tea leaves.

**CO3:** To learn about preparation of simple syrup as per IP and USP.

**CO4:** Morphology of turmeric, Ginger and mentha.

**CO5:** Preparation of suspension emulsion on it means in organic separations pharmaceutical buffer solutions.

**GENERIC ELECTIVE 1**

**PROCESSING OF FATS AND OILS**

*After completing this course the student will-*

**CO1:** Gain knowledge about traditional Indian oil and traditional Indian oil processing methods.

**CO2:** Gain the knowledge about importance type natural resources of fats and oils and their effect on health.

**CO3:** Learn the method of refining and modification of fats and oils..

**CO4:** Know about the nutritional aspects of fats and oils and their storage and handling.

**CO5:** Gain information regarding entrepreneurship in food processing and knowledge of local processing industries.

**GENERIC ELECTIVE**

ENVIRONMENTAL TOXICOLOGY

*By the end of the scores students are expected to-*

- |             |   |
|-------------|---|
| <b>CO1:</b> | <i>Learn about definition and sources of toxicants.</i>   |
| <b>CO2:</b> | <i>Learn about chemical toxicants biological toxicants and its assessment.</i>  |
| <b>CO3:</b> | <i>Learn about different parts of ecotoxicology i.e. Immunotoxicology, Xenoviotics, neurotoxicology, bioaccumulation, biodegradation etc.</i> |
| <b>CO4:</b> | <i>Learn about the determination of acceptable risks and limits of environmental toxicants and utility of environmental benchmarks.</i>       |
| <b>CO5:</b> | <i>Learn about environment al cytotoxicity and genotoxicity.</i>  |
| <b>CO6:</b> | <i>Learn about what type of toxic chemicals affects in environment and solid West management.</i>   |
| <b>CO7:</b> | <i>Learn about which factors influence the toxicity.</i>  |

## M. Sc. Chemistry

### Course Outcome

This program is designed with an objective to cover all important topics of physical, inorganic, organic and analytical branches so that students will be able to use this knowledge in advancement of their career.

### M. Sc. First Semester

**Course** On completion of this course, successfully students will be able to learn:

**outcome** *Title of the paper*

#### FIRST PAPER (MCH 101) INORGANIC CHEMISTRY

- |             |   |
|-------------|---|
| <b>CO1:</b> | Stereochemistry, bonding, VSEPR theory, MO treatment      |
| <b>CO2:</b> | Reaction mechanism of Substitution inertness and lability |

CO3:	Electronic spectra of transition metal complexes
CO4:	Metal carbonyls, Dioxygen Complexes
CO5:	Wilkinson's Catalyst, borane chemistry including topology, nomenclature, reactivity and bonding.

### SECOND PAPER (MCH102) ORGANIC CHEMISTRY

CO1:	Structure and bonding in organic molecules
CO2:	Aromaticity, antiaromaticity, homo aromaticity including weaker bonds.
CO3:	Stereochemistry, symmetry, chirality, optical activity and conformational analysis,
CO4:	Reaction mechanism, Hammett equation, SN1, SN2 and SET mechanism,
CO5:	UV-VIS, ORD & CD Spectroscopy.

### THIRD PAPER (MCH 103) PHYSICAL CHEMISTRY

CO1:	Schrodinger Wave equation, variation and perturbation theory,
CO2:	Classical thermodynamics,
CO3:	Phase rule, chemical dynamics, Arrhenius Equation,
CO4:	Theory of reaction rate and application of rate law on dynamic chain reaction
CO5:	Reaction catalysts.

### FOURTH PAPER (MCH104) SPECTROSCOPY

CO1:	Electromagnetic spectrum
CO2:	Microwave spectroscopy
CO3:	Infrared Spectroscopy
CO4:	Raman and Electronic spectroscopy.
CO5:	CARS (Coherent and Stokes Raman Spectroscopy) and application of these spectral techniques in structure determination of molecule.

### FIFTH PAPER (MCH 105 A) MATHEMATICS FOR CHEMIST



CO1:	Basic concept of mathematical technique involved in Chemistry like Mathematics Algebra
CO2:	Differential calculus, integral calculus,
CO3:	Elementary differential equation
CO4:	Permutation
CO5:	Probability.

#### FIFTH PAPER (MCH 105 B) BIOLOGY FOR CHEMIST

CO1:	Cell structure
CO2:	Cell organs, and their function
CO3:	Carbohydrates,
CO4:	Lipids and fats, amino acids
CO5:	Nucleic acids.

#### LABORATORY COURSE: CHEMISTRY PRACTICAL COURSE MCH 106: INORGANIC CHEMISTRY

CO1:	Qualitative and Quantitative Analysis
CO2:	Chromatography
CO3:	Preparations- Preparation of selected inorganic complexes and their studies by measurements of decomposition temperature, molar conductance, IR and electronic spectra.

#### COURSE MCH 107: ORGANIC CHEMISTRY

CO1:	Qualitative Analysis: Separation, purification and identification of compounds of binary mixture. Emphasis should be placed on physical principles, reaction chemistry and the technique involved in analysis.
CO2:	Organic Synthesis-Purification of compounds by TLC and column chromatography.
CO3:	Aromatic electrophilic substitutions, Reduction reaction
CO4:	Quantitative Analysis- <i>Determination of the percentage or number of hydroxyl groups</i>

in an organic compound by acetylation method

### COURSE MCH 108: PHYSICAL CHEMISTRY

CO1:	Adsorption
CO2:	Phase Equilibria
CO3:	Chemical Kinetics
CO4:	Solutions

## M. Sc. Second Semester

Course On completion of this course, successfully students will be able to:  
outcome **Title of the paper**

### FIRST PAPER (MCH 201) INORGANIC CHEMISTRY

CO1:	Metal ligand equilibrium, reaction mechanism, base hydrolysis, conjugate base mechanism in octahedral and mechanism of square planar complexes.
CO2:	Metal-ligand bonding
CO3:	Calculations of $Dq$ , $B$ and beta parameters
CO4:	Preparation, properties, structure and applications of metal nitrosyls.
CO5:	Symmetry elements, symmetry operations and the principle involved in group theory.

### SECOND PAPER (MCH 202) ORGANIC CHEMISTRY

CO1:	Mechanism- aromatic/aliphatic electrophilic substitution
CO2:	Free radical, allylic halogenation reaction,
CO3:	Addition to carbon-carbon and carbon-hetero atom multiple bond and aromatic nucleophilic substitution, $SE1$ , $SE2$ , $SN1$ $SN2$ & $SRN1$ reactions.
CO4:	ESR Spectroscopy
CO5:	IR and Raman spectra and their application in characterization of organic

compounds.

### THIRD PAPER (MCH 203) PHYSICAL CHEMISTRY

CO1:	Chemical dynamics
CO2:	Adsorption and electrokinetic phenomenon,
CO3:	Micellization, DHO equation.
CO4:	Lipmann electro-capillary phenomenon including different models.
CO5:	Macromolecules and colloid including their types, emulsification, irreversible electrode phenomenon including decomposition voltage overlaps.

### FOURTH PAPER (MCH 204) SPECTROSCOPY & DIFFRACTION METHODS

CO1:	Photoelectron spectroscopy, photoacoustic spectroscopy,
CO2:	X ray Diffraction, Neutron Diffraction.
CO3:	Biological cell, constituents,
CO4:	Bioenergetics
CO5:	Thermodynamics of biopolymer solution and transport of ion through the cell membrane.

### FIFTH PAPER (MCH 205) COMPUTER FOR CHEMIST

CO1:	Basic knowledge of computer and computing
CO2:	BASIC and FORTRAN based programming with especial reference to programming in chemistry.
CO3:	Rerunning of standard program in MS Word and MS Excel
CO4:	Search engines and various types of files like PDF, RTF, JPG
CO5:	OMR & Webcam.

### LABORATORY COURSE: CHEMISTRY PRACTICAL

### COURSE MCH 206: INORGANIC CHEMISTRY

CO1:	Chromatography Separation of cations and anions by Column Chromatography
CO2:	Estimation of Ni – Fe, Ni (Gravimetrically), Fe (Volumetrically)
CO3:	Preparations- Preparation of selected inorganic complexes and their studies by measurements of decomposition temperature, molar conductance, IR and electronic spectra.
CO4:	Interpretation of TG and NMR spectra of some known compounds

### COURSE MCH 207: ORGANIC CHEMISTRY

CO1:	Qualitative Analysis: Separation, purification and identification of compounds of binary mixture. Emphasis should be placed on physical principles, reaction chemistry and the technique involved in analysis.
CO2:	Preparation of phenyl azo – $\beta$ – naphthol from aniline.
CO3:	Aromatic electrophilic substitutions, Reduction reaction
CO4:	Quantitative Analysis- <i>Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method</i>

### COURSE MCH 208: PHYSICAL CHEMISTRY

CO1:	<i>Electrochemistry</i>
CO2:	<i>Conductometry</i>
CO3:	<i>Potentiometry/pH merry</i>
CO4:	<i>Polarimetry</i>

## M. Sc. Third Semester

Course Outcome      On completion of this course, successfully students will be able to:  
outcome      **Title of the paper**

### FIRST PAPER (MCH 301) INORGANIC CHEMISTRY

CO1:	Group theory, Character tables, orthogonality theorem, applications for C <sub>2v</sub> and
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	C <sub>3v</sub> point groups
CO2:	Correlation of vibrational spectroscopy with group theory. They will also understand molecular energy levels and M.O. Diagrams, bonding of multidentate ligands, characterization by IR & Raman spectroscopy.
CO3:	Shift reagents in NMR spectroscopy
CO4:	Structure and functioning of metalloenzymes e.g., carboxypeptidase, carbonic anhydrase
CO5:	Structure and functioning of biomolecules like Hemoglobin.

### SECOND PAPER (MCH 302) ORGANIC CHEMISTRY

CO1:	Basic theory of NMR spectroscopy, applications to characterize organic compounds.
CO2:	Photochemical reactions.
CO3:	Mechanism of pericyclic reaction, विकास
CO4:	Woodward-Hoffmann, FMO & PMO approach
CO5:	Sigma tropic rearrangements.

### THIRD PAPER (MCH 303) PHYSICAL CHEMISTRY

CO1:	Atomic concepts, Russell-Saunders terms and coupling. Molecular Orbitals, Huckel theory of conjugated systems like ethylene, butadiene
CO2:	Homo and heterogeneous catalysis.
CO3:	Crystal defects. Schottky and Frankel defects
CO4:	Solid state reactions. Metallic bond
CO5:	Conductors, semiconductors, insulators and superconductors

### FOURTH PAPER (MCH 304 B) ANALYTICAL CHEMISTRY

CO1:	Statistical Analysis., Sample Preparation for Chromatography.
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CO2:	Chromatography. Theory of Chromatography, Gas Chromatography, High-Performance Liquid Chromatography, Capillary Electrophoresis.
CO3:	Ion Exchange, Solvent Extraction
CO4:	Atomic Absorption Spectrometry, Electrolytic Methods
CO5:	Acid-Base Titrations, Precipitation Titrations, Complexometric Titrations, Redox Titrations.

### FIFTH PAPER (MCH 304C) ELECTIVE PAPER: PHOTOCHEMISTRY

CO1:	Photochemical Reactions
CO2:	Determination of Reaction Mechanism
CO3:	Photochemistry of Alkene
CO4:	Photochemistry of Carbonyl
CO5:	Miscellaneous Photochemical Reactions, Photo degradation of polymers. Photochemistry of vision.

### LABORATORY COURSE: CHEMISTRY PRACTICAL COURSE MCH 306: INORGANIC CHEMISTRY

CO1:	<b>Synthesis</b> Synthesis of selected inorganic compounds and their studies by measurements of decomposition temperatures and molar conductance, magnetic and IR electronic spectra.
CO2:	Qualitative test of suitable anion and determination of metal content gravimetrically in the above compounds.
CO3:	Interpretation of ESR and mass spectra of some known coordination compounds.

### COURSE MCH 307: ORGANIC CHEMISTRY

CO1:	Qualitative Analysis
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Separation, purification and systematic identification of the components of a mixture of three organic compounds (solids and liquids). Preparation of one derivative of each compound. Use of TLC for ascertainment of purity of compounds.

**CO2:** **Multi-step Synthesis**  
This exercise should illustrate the use of organic reactions/ diverse conditions and principles for organic synthesis. Purification of compounds by chromatographic techniques.

### COURSE MCH 308: PHYSICAL CHEMISTRY

**CO1:** Potentiometry

**CO2:** Conductivity

**CO3:** Spectrophotometry

**CO4:** Molecular Modeling

## M.Sc. Fourth Semester

*Course outcome* On completion of this course, successfully students will be able to:

*outcome* **Title of the paper**

### FIRST PAPER (MCH 401) INORGANIC CHEMISTRY

**CO1:** ESR Spectroscopy

**CO2:** Mossbauer, IR, Raman spectroscopy,

**CO3:** Point groups and vibrational spectroscopy.

**CO4:** Bio-inorganic chemistry, chlorophyll, photo systems one and two,

**CO5:** Metalloproteinscytochromes, iron Sulphur protein, Nitrogen fixation.

### SECOND PAPER (MCH 402) ORGANIC CHEMISTRY

**CO1:**  $^{13}\text{C}$  NMR Spectroscopy

CO2:	Mass spectroscopy.
CO3:	Reaction mechanism of elimination, E1, E2 & E1CB type,
CO4:	Substitution reactions.
CO5:	Enzymes, structure and functioning.

### THIRD PAPER (MCH 403) PHYSICAL CHEMISTRY

CO1:	NMR, ESR spectroscopy.
CO2:	Laws of photochemistry, fluorescence,
CO3:	Steric and conformational properties of molecules,
CO4:	Winstein-Holmer and Curtin-Hammett Equations
CO5:	CO5: Electronic effects involved in SN1 and SN2 type of reactions, and curve crossing model.

### FOURTH PAPER (MCH404) POLYMER CHEMISTRY

CO1:	Basic theory, classification of polymers
CO2:	Characterization, important properties of polymers
CO3:	Commercial importance of polymers
CO4:	Processing to understand different types of casting like die-rotational, film
CO5:	Methods for designing variety of polymers

### FIFTH PAPER (MCH 405A) ELECTIVE: CHEMISTRY OF NATURAL PRODUCTS

CO1:	<i>Terpenoids</i>
CO2:	<i>Alkaloids</i>
CO3:	<i>Steroids</i>
CO4:	<i>Plant Pigments. Carotenoid, Flavonoids, Chlorophyll</i>
CO5:	<i>Vitamins and Antibiotics, Antibiotics.</i>



**LABORATORY COURSE: CHEMISTRY PRACTICAL**

**COURSE MCH 406: INORGANIC CHEMISTRY**

<b>CO1:</b>	Spectrophotometric Determination
<b>CO2:</b>	Flame photometric determination
<b>CO3:</b>	Model Experiments on Cyclic Voltammetry
<b>CO4:</b>	Interpretation of ESR, NMR and Thermogravimetric pre-recorded results of known compounds

**COURSE MCH 407: ORGANIC CHEMISTRY**

<b>CO1:</b>	Multi-step Syntheses - Qualitative & Quantitative
<b>CO2:</b>	Quantitative Analysis
<b>CO3:</b>	Spectral Analysis: Interpretation of pre-recorded UV-Vis, IR, NMR, Mass, Raman spectrum and characterization of one organic compound.

**COURSE MCH 408: PHYSICAL CHEMISTRY**

<b>CO1:</b>	Spectrophotometry
<b>CO2:</b>	Chemical Kinetics
<b>CO3:</b>	Electronics
<b>CO4:</b>	Molecular Modeling

