



**PROGRAMME SPECIFIC OUTCOMES
AND COURSE OUTCOMES OF
CHEMISTRY (UG & PG)**

VISION

To serve the state and Nation by educating and imparting values based quality education to students, by advancing scientific knowledge, promoting research through multidisciplinary collaborations and helping in economics development.

MISSION

- (1) Make students aware about global changes, innovations, sustainability impacting societies.
- (2) Equip students with skills required to face modern world challenges.

Programme Outcomes

GRADUATION CHEMISTRY

- ✓ **PO1. Knowledge and theory –**
Apply their board knowledge of science across a range of fields, with in depth knowledge in at least one area of study. While demonstrating an understanding of the local and global contexts in which science is practiced.
- ✓ **PO2. Application-**
Apply appropriate methods of research, investigation and design.
- ✓ **PO3. Proficiency in technology-**
Recognize the need for information employ highly developed conceptual, analytical, quantitative and technical skills and are adept with a range of technologies.
- ✓ **PO4. Team work-**
Work effectively in groups to meet a shared goal with people whose disciplinary and cultural backgrounds differ from their own.
- ✓ **PO5. Communicate-**
Clearly and convincingly about science and technology ideas practices.
- ✓ **PO6. Professional and ethical behavior-**
Demonstrative personal and professional integrity by respecting diverse point of view and the intellectual contribution of others.
- ✓ **PO7. Problem solving and critical thinking-**
Critically evaluate ideas and arguments by gathering relevant information, assessing its credibility and synthesizing evidence to formulate a position.
- ✓ **PO8. Environment Sensitivity –** To sensitize young ones towards environment and sustainability and significance of sustainable development.

POST GRADUATION CHEMISTRY

- ✓ **PO1. Mastery of the Knowledge** in their fields and the ability to apply their expertise to novel and emerging problems.
- ✓ **PO2. Effective researches-** Able to state a research problem, apply research methods , tools for data collection, analyze and interpret research data.
- ✓ **PO3. Professional and ethical responsibilities –** Expected to broaden their professional foundations through activities such as internships, fellowships, teaching and project work.
- ✓ **PO4. Originality-**Conduct original work in the field or complete a substantial project related to the field.
- ✓ **PO5. Skills-**
 - a. **Demonstrate critical thinking**, apply analytical models and critical, reasoning propellers to calculate evidence, select among alternatives and generate creative options.
 - b. **Possets effective communication skills** in oral & written form. Communicate their research clearly and professionally in both written and oral forms appropriate to the field through publications, conference papers, seminars etc.

c. **Demonstrate teamwork and leadership skill**, specifically function in a variety of work groups.

6. Proficiency in using technology- Students will be apprised of various modern technologies and its significance in the modern world. They will gain proficiency in using technology.

PhD PROGRAMME (CHEMISTRY)

- ✓ **PSO1.** Apply theory and methodologies within these areas to conduct independent research that addresses scientific and technological problems in broad chemical interest.
- ✓ **PSO2.** Become independent, motivated researchers in a specific area of study with the ability to recognize and address important scientific problems.
- ✓ **PSO3.** Make original contribution to scientific advancements.
- ✓ **PSO4.** Present an original proposal summarizing the existing literature in their area of study, posing a question or hypothesis, investigating and advancing the state of knowledge in this area.
- ✓ **PSO5.** Effectively communicate the results of their research in peer reviewed journals articles and in oral presentations to chemistry faculty and students. At the local, regional & national conferences.

PROGRAMME - B.Sc.(CHEMISTRY)

PROGRAM OUTCOMES

- ✓ **PO-1.** Understand the basic concepts of science and able to correlate them with their daily life.
- ✓ **PO-2.** Develop skill of handling instruments, performing experiments and logical analysis of the experimental results.
- ✓ **PO-3.** Analyse the every situation of day to day life with scientific approach and able to draw objective conclusion for the betterment of society and humanity.
- ✓ **PO-4:** To educate students on topics: Periodic Classification of Elements and Chemical Bonding
- ✓ **PO-5:** To educate students on basic organic chemistry of saturated and unsaturated hydrocarbons along with introduction to different types of reactions.
- ✓ **PO-6:** To expose students on radical analysis in inorganic mixtures; determination of surface tension and viscosity of liquids.
- ✓ **PO-7:** To make students aware about 's', 'p' and Zero Group elements and their related chemistry
- ✓ **PO-8:** To educate students on the topics: chemical kinetics, photochemistry and macromolecules.
- ✓ **PO-9:** To provide laboratory experience to the students by performing volumetric analysis for determination of equivalent weight of acids and experiments based on organic compounds synthesis and their purification methods.
- ✓ **PO-10:** To provide opportunity and experience of presenting seminar on pre-allotted topics related to theory.

SCHEME OF EXAMINATION

Subject	Paper	Max. Mark	Total Marks	Min. Marks
Environmental Studies		75	100	33
Field Work		25		
Foundation Course				
Hindi Language	I	75	75	26
English Language	I	75	75	26
नोट- प्रत्येक खंड में से 2 दो प्रश्न हल करने होंगे। सभी प्रश्नपत्र समान अंक के होंगे।				
Three Elective Subject:				
1. Physics	I		50	
	II		50	100
	Practical			50
				17
2. Chemistry	I		33	
	II		33	100
	III		34	

COURSE PROFILE (B.Sc. CHEMISTRY)

Paper	Name of Paper
Paper I	Inorganic Chemistry
Paper II	Organic Chemistry
Paper III	Physical Chemistry

COURSE OUTCOMES

PAPER	PAPER NAME (PAPER CODE)	OUTCOMES
		After completion of the course the student should be able to
<u>B.Sc. I</u>		
PAPER I	INORGANIC CHEMISTRY	CO –1 To get the knowledge of the structure of atom and periodicity in the properties of elements
		CO – 2. To get the knowledge of the process of formation of ionic bond and properties of ionic solids
		CO – 3 To get the knowledge of the theories of covalent bond formation
		CO – 4. Know the salient features of s and p block elements
		CO – 5. To get the knowledge of the chemistry of noble gases and theoretical principles involved in qualitative analysis
PAPER II	ORGANIC CHEMISTRY	CO – 1. To get the knowledge of the basic concepts and electronic effects of organic chemistry.
		CO – 2. Know the stereochemistry of organic molecules
		CO – 3. To get the knowledge of the conformational analysis of alkanes
		CO – 4. Understand the chemistry of alkane, alkene and alkyne
		CO – 5. Know the concept of aromaticity and electrophilic substitution reaction in aromatic compounds
PAPER III	PHYSICAL CHEMISTRY	CO – 1. To get the knowledge of the basic mathematical concept used in chemistry
		CO – 2. Understand the kinetic molecular model of gas and understand the behaviour of real gases
		CO – 3. To get the Knowledge of the intermolecular forces and understand colloid and surface chemistry
		CO – 4. Understand the symmetry, crystal system and crystal defects
		CO – 5. Know the rate of reaction, factors affecting it and theories of reaction rate and catalysis.
LAB COURSE	INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY	CO – 1. To get knowledge of the inorganic mixtures by the Semi-micro qualitative analysis
		CO – 2. Understand the strength of unknown solution by volumetric method
		CO – 3. Get the knowledge of elements (N, S and halogens) and functional groups in organic compounds
		CO – 4. Understand the measurement and composition of a binary liquid mixture by surface tension method
		CO – 5 To know the composition of a binary liquid mixture by viscometer

<u>B.Sc. II</u>		
PAPER I	INORGANIC CHEMISTRY	CO – 1. To get the knowledge of chemistry of transition series elements CO – 2. To get the knowledge of the redox potential data & its application and chemistry of coordination compounds CO – 3. Understand the valance bond theory and crystal field theory CO – 4. To know the chemistry of lanthanides and actinides CO – 5. Understand the theories of acid and bases and physical properties & chemical reactions of non-aqueous solvents
PAPER II	ORGANIC CHEMISTRY	CO – 1. To get the knowledge of the mechanism of nucleophilic substitution and elimination reactions CO – 2. Understand the preparation, properties and reactivity of alcohol and phenol CO – 3. To Know the nomenclature, structure and reactivity of carbonyl group CO – 4. To get the knowledge of chemistry of carboxylic acid and its derivatives CO – 5. To get the knowledge of the reactivity, structure and properties of organic compounds of nitrogen
PAPER III	PHYSICAL CHEMISTRY	CO – 1. To know the laws of thermodynamics and know the meaning of various thermodynamic terms CO – 2. To get knowledge of the concept of entropy and free energy CO-3. Understand the chemical & ionic equilibrium and equilibrium constant CO – 4. To get the knowledge of the phase rule and its application to one, two and three component system CO-5. Get the knowledge of characteristics of electromagnetic radiation, laws of photochemistry and quantum yield
LAB COURSE	CHEMISTRY PRACTICAL	CO – 1. Understand the semimicro analysis of mixtures containing interfering radicals. CO – 2. Determine the strength of solution by volumetric method CO – 3. To get the knowledge of specific organic compound CO – 4. Understand the R _f value and identify organic compound through paper chromatography CO – 5. To get the knowledge the enthalpy of chemical reactions

<u>B.Sc. III</u>		
PAPER I	INORGANIC CHEMISTRY	CO – 1. Know the metal-ligand bonding in transition metal complexes CO – 2. To get the knowledge of magnetic properties of transition metal complexes CO – 3. To Know the classification, properties, bonding and applications of organometallic compounds CO – 4. Understand the essential and trace elements in biological processes CO – 5. To get the knowledge of concept of hard and soft acid and base and inorganic polymers
PAPER II	ORGANIC CHEMISTRY	CO – 1. Understand the heterocyclic organic compounds CO – 2. To get the knowledge of organometallic compounds CO- 3 To get the knowledge of understand the knowledge CO – 4 Understand the chemistry of synthetic polymers and dyes CO – 5. Understand the principle and applications of NMR, IR and UV – Visible spectra
PAPER III	PHYSICAL CHEMISTRY	CO – 1. To get the knowledge of basic concept of quantum mechanics along with Schrodinger's equation & its applications CO – 2. Know the quantum mechanical approach of molecular orbital theory CO – 3. Get the knowledge of principle and applications of Microwave, Infrared and Raman spectra CO – 4. Understand the concept electrochemistry for electrolytes CO – 5. Understand the different types of electrochemical cell and their potential
LAB COURSE	CHEMISTRY PRACTICAL	CO – 1. Synthesis of inorganic complexes CO – 2. Gravimetric estimation of element CO – 3. Synthesis of Organic Compounds CO – 4. Analysis of an organic mixture containing two solid components CO – 5. Determine the strength of acid or base by conductometric titration

PROGRAM - M.SC.(CHEMISTRY)**COURSE OBJECTIVES**

This course aims at acquainting students to concept of Crystal field and Lig and field theory. The symmetry, magnetic properties and spatial arrangements of molecules are studied in good detail. This course also aims at to accustom the students the basic concepts of thermodynamics along with the Non-ideal systems including the basic Debye Huckel theory. Modern theoretical and experimental methods used to study problems of molecular structure and bonding; emphasis on spectroscopic techniques.

COURSE PROFILE**M.Sc. Ist Semester**

Paper	Name of Paper
Paper I	Group theory and Chemistry of Metal Complexes
Paper II	Concept in Organic Chemistry
Paper III	Quantum Chemistry, Thermodynamics and Chemical Dynamics-I
Paper IV	Theory and Applications of Spectroscopy-I

COURSE OUTCOME

At the end of this course, a student will have developed ability to:

PAPER NAME	COURSE	OUTCOMES
PAPER I	GROUP THEORY AND CHEMISTRY OF METAL COMPLEXES	CO-1. Get the knowledge of actual structure of elements.
		CO-2. To understand the metal-ligand bonding in metal complexes.
		CO-3. Study the metal-ligand equilibria in solution.
		CO-4. Understand the structure and properties of metal clusters.
PAPER II	CONCEPT IN ORGANIC CHEMISTRY	CO-1. To understand the nature of bonding in organic molecules and the concept of aromaticity.
		CO-2. Understand the Conformational analysis and stereochemistry of organic molecules.
		CO-3. Study the reaction intermediates and elimination reactions of organic molecules.
		CO-4. Get the knowledge of the pericyclic reactions of organic compounds.
PAPER III	QUANTUM CHEMISTRY, THERMODYNAMICS AND CHEMICAL DYNAMICS-I	CO-1. Understand the basic mathematical concept used in quantum chemistry.
		CO-2. Understand the basic concepts of thermodynamics.
		CO-3. Study the basics of electrochemistry.
		CO-4. Understand the rate of reaction and theories of reaction rate.
PAPER IV	THEORY AND APPLICATIONS OF SPECTROSCOPY-I	CO-1. To gain insight into the basic principle of molecular spectra, types of spectra and its origin.
		CO-2. To know about rigid rotor, energy levels, origin of rotational spectra and its applications.
		CO-3 To get the knowledge of electron diffraction, augur spectroscopy, turbidity, nephelometry, fluorometry,
		CO-4. To understand the theories/principles, predict the functional groups and differentiate between IR and Raman spectra.
LAB COURSE I	INORGANIC CHEMISTRY	To get the knowledge of cation, anion, rare earth elements including interfering radicals, volumetric estimation and gravimetric estimation
LAB COURSE II	PHYSICAL CHEMISTRY	To get the knowledge of adsorption, surface, phase equilibrium, chemical kinetics, conduct metric, pH, potentiometer titration

SYLLABUS
M.Sc.-2nd Semester

Paper	Name of Paper
Paper I	Transition metal complexes
Paper II	Reaction Mechanism
Paper III	Quantum chemistry, Thermodynamics and Chemical Dynamics-II
Paper IV	Theory and Applications of Spectroscopy-II

COURSE OUTCOME

At the end of this course, a student will have developed ability to:

PAPER	PAPER NAME	COURSE OUTCOME
Paper I	TRANSITION METAL COMPLEXES	CO-1. To understand the reaction mechanism of transition metal complexes
		CO-2. To understand how to interpret electronic spectra of complexes and know magnetic properties of complexes of different geometry.
		CO-3. To understand transition metal complexes with unsaturated organic molecules.
		CO-4. To study the alkyl and aryl of transition metals.
PAPER II	REACTION MECHANISM	CO-1. To have a thorough idea about the basic concepts and reaction mechanism of various types of organic reactions.
		CO-2. To get an idea about the mechanism and stereochemical aspects of elimination reactions.
		CO-3. To understand the mechanism and stereochemistry of nucleophilic substitution reactions.
		CO-4. To acquire the knowledge of mechanism of electrophilic substitution in aliphatic as well as aromatic compounds.
PAPER III	QUANTUM CHEMISTRY, THERMODYNAMICS AND CHEMICAL DYNAMICS-II	CO-1. To have basic knowledge of mathematics – vector, matrix algebra, probability, calculus and its application in chemistry which adds value to the programme.
		CO-2. To illustrate the concepts in statistical thermodynamics – distribution, thermodynamic probability, partition function and its application and to compare Maxwell-Boltzmann, Bose- Einstein and Fermi-Dirac Statistics.

		<p>CO-3. To explain and derive equations related to the theory of strong electrolytes – structure/models and thermodynamics of electrified interfaces, polarography and its applications.</p> <p>CO-4. To describe different theories of reaction rates, fast reactions and its methods, kinetics and mechanism of photochemical and unimolecular reactions.</p>
PAPER IV	THEORY AND APPLICATIONS OF SPECTROSCOPY-II	<p>CO-1 To get the knowledge of electronic spectra, frank condon principal, rotational and transitional of organic molecule</p> <p>CO-2. To gain detailed insight into the instrumentation and sample handling in IR spectroscopy, characteristic vibrational frequencies and factors effecting.</p> <p>CO-3. To acquaint with the principle and interpretation of Mass spectra and to elucidate structure of molecule on the basis of various spectral spectroscopic data.</p> <p>CO-4. To get to know in detail about the various effects, mechanism, correlations and advanced techniques related to proton and C-13 NMR spectroscopy.</p>
LAB COURSE III	ORGANIC CHEMISTRY	Understand the process of solvent extraction, distillation technique, binary mixture, synthesis of binary compound
LAB COURSE IV	ANALYTICAL CHEMISTRY	Understand the computer programmes, linear regression, MS office, Excel, flame photometer, nephelometer, electrophoresis, Lambert beers law

SYLLABUS

M.Sc.-3rd Semester

Paper	Name of Paper
Paper I	Resonance spectroscopy, Photochemistry and Organocatalysis
Paper II	Chemistry of Biomolecules
Paper III	Catalysis, solid state and surface chemistry
Paper IV	Analytical chemistry

COURSE OUTCOME

At the end of this course, a student will have developed ability to:

PAPER	PAPER NAME	COURSE OUTCOME
<u>PAPER I</u>	RESONANCE SPECTROSCOPY, PHOTOCHEMISTRY AND ORGANOCATALYSIS	CO-1. Explain relevant terms of ESR, NQR, PE and PAS spectroscopy.
		CO-2. Explain basic and working principle of ESR, NQR, PE and PAS spectroscopy.
		CO-3. Taking resonance spectra and their interpretation.
		CO-4. Explain mechanism of photochemical reactions and organocatalysis.
<u>PAPER II</u>	CHEMISTRY OF BIOMOLECULES	CO-1. The basic properties of enzymes, components of metabolic pathway and kinetics of enzyme action.
		CO-2. Mechanisms of enzyme action and different kinds of enzyme catalyzed reactions.
		CO-3. Different models of enzymes and co-enzymes, their structures and biological functions.
		CO-4. Biotechnological applications of enzymes and constituents of biological cell.
<u>PAPER III</u>	CATALYSIS, SOLID STATE AND SURFACE CHEMISTRY	CO-1. Gives an introduction to solid state chemistry and crystal defects.
		CO-2. Explain types and electrical properties of semiconductors.
		CO-3. Explain the mechanism of homogenous and heterogenous catalysis.
		CO-4. Explain adsorption process and its mechanism on the surface.
<u>PAPER IV</u>	ANALYTICAL CHEMISTRY	CO-1. Explain the fundamentals of analytical chemistry and steps of a characteristic analysis.
		CO-2. Express the role of analytical chemistry in science.
		CO-3. Explain the quantitative analytical methods and compare qualitative and quantitative analytical methods.
		CO-4. Elucidate the solvent extraction techniques and their classification.
LAB COURSE V	PHYSICAL CHEMISTRY	Understand the process of solvent extraction volumetric conduct metric determination and reactions kinetics of different types of reactions
LAB COURSE VI	ANALYTICAL CHEMISTRY	To get the knowledge of qualitative and quantitative determination of metal ions by spectrophotometer, polarometer, pH meter, NMR, GC-MS, AAS,

SYLLABIS
M.Sc.-4thSemester

Paper	Name of Paper
Paper I	Instrumental methods of analysis
Paper II	Natural products and medicinal chemistry
Paper III	Nuclear chemistry
Paper IV	Environmental chemistry

COURSE OUTCOME

At the end of this course, a student will have developed ability to:

PAPER	PAPER NAME	COURSE OUTCOME
PAPER I	INSTRUMENTAL METHODS OF ANALYSIS	CO-1. Evaluate electromagnetic radiation properties.
		CO-2. Explain the interaction of electromagnetic radiation with matter.
		CO-3. Classify basic principles of spectroscopic methods.
		CO-4. Interpretation of all spectrums.
PAPER II	NATURAL PRODUCTS AND MEDICINAL CHEMISTRY	CO-1. Knowledge of chemistry and significance of Terpenes.
		CO-2. Structure and biosynthesis of Steroids.
		CO-3. To know about the basics of drugs, drug design and important pharmacokinetic parameters.
		CO-4. To understand biosynthesis/synthesis, structure and applications of antibiotics.
PAPER III	NUCLEAR CHEMISTRY	CO-1. Identify and define various types of nuclear transmutation including fission, fusion and decay reactions.
		CO-2. State and compare the differences and similarities between a nuclear change and a chemical change.
		CO-3. Understand and explain the concept of isotopic stability including the band of stability.
		CO-4. Explain the concept of rate of change of half life in the context of nuclear decay.
PAPER IV	ENVIRONMENTAL CHEMISTRY	CO-1. Appreciate concepts and methods from ecological science and solving environmental problems.
		CO-2. Explain the ethical, cross-cultural and historical context of environmental issues.
		CO-3. Discuss the link between human and natural

		systems.
		CO-4. Able to recognise the physical, chemical and biological components of the earth's systems and show how they function.
LAB COURSE VII	ORGANIC CHEMISTRY	Understand the multi step synthesis, qualitative synthesis, estimation of functional group
LAB COURSE VIII	ANALYTICAL CHEMISTRY	Understand the process of spectrophotometer determination, flow injector analysis, AAS, titrimetric and gravimetric analysis and chromatographic separation of metal ions



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