

### Course Outcomes: Department of Chemistry

In B.Sc (M/NM) the Chemistry curriculum is so designed to provide the students a comprehensive understanding about the fundamentals of chemistry covering all the principles and perspectives and make them understand the central role of chemistry in our society and become potent enough to explore new areas of research both in chemistry and in allied fields of research and technology. The branches of Chemistry such as Organic Chemistry, Inorganic Chemistry and Physical Chemistry expose the diversified aspects of chemistry where the students experience a broader outlook of the subject.

The practical exercises done in the laboratories impart the students the knowledge about various chemical reagents and reactions. Thereby, sharpen their skills of handling the corrosive, poisonous, explosive and carcinogenic chemicals making themselves employable in any kind of chemical industries. They are also trained about the adverse effects of the harmful chemicals. Further the students get well versed in handling instruments like pH meter and conductometer which are used in various industries to check quality of drinking water and determine salinity and TDS. Students are also trained about various analytical techniques such as redox titrations, Acid-base Titrations. Complexometric Titrations that can be used at industrial level for qualitative and quantitative analysis.

They will utilize this knowledge to avail opportunities related to chemistry in the government services through public service commission particularly in the field of health inspector, food safety, food inspector, pharmacist and in the chemical industry like cement industries, agro product, Paint industries, Rubber industries, Petrochemical industries, Food processing industries, Fertilizer industries etc.

<b>B.Sc (Medical/Non- medical)- Semester – I</b>	<b>-1</b>	<b>Paper-I: Inorganic Chemistry</b>  a. By Studying this course Students will be able to understand the Atomic Structure by visualizing the interior of atoms and molecules and predict the properties of matter.  b. Study the shape of orbitals with the help of quantum number.  c. Student will understand the modern periodic table which is the backbone in understanding Chemistry and the periodic properties like Atomic and Ionic size, Ionization Energy Electron Affinity,
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Electro negativity

- d. Noble Gases are one part of the periodic table which is not that much reactive which can be easily utilized in understanding the behavior of the inert gases.
- e. Learn the importance and limitations of valence bond theory and use them for predicting the shapes and hybridization of inorganic molecules and ions.
- f. Understand the importance of VSPER theory and MO theory and apply them to homonuclear and heteronuclear molecules

**Paper-II: Organic Chemistry**

- a. Learn the Some basic concepts of organic chemistry such a Hybridization, bond lengths and bond angles, bond energy, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding
- b. Students will be able to study the subject understanding the basic things for chemical reactions i.e. Substrate and Reagents Types of reagents Electrophilic and Nucleophilic Homolytic and heterolytic fission. Electron mobility Inductive effect, Resonance effect etc
- c. Many of the daily used materials are organic compounds and majority of them are hydrocarbons therefore this topic explain the method of preparation, physical and chemical properties of alkanes.
- d. Study about the Nomenclature, method of preparation, physical and chemical properties of variouss functional groups suc as cycloalkanes, alkene, cycloalkenes. dienes and alkynes.

**Paper -III: Physical Chemistry**

- a. Basic Mathematics is comprehended by students such as differentiation, integration, log and simple calculations.
- b. Tests to check reliability of experimental results are understood, which is helpful during experimental work also.
- c. Study about nature of liquid and gases in detail their molecular structure, physical properties, magnetic & electrical properties.

	<p><b>Practical chemistry - I</b></p> <p>Students will be able to qualitatively analyze, separate and identify the different cations and anions from Groups I, II, III, IV, V and VI present in a salt</p>
<p><b>B.Sc -1</b> <b>(Medical/Non-medical)-</b> <b>Semester II</b></p>	<p><b>Paper-I Inorganic chemistry</b></p> <p>Students will be able to</p> <ol style="list-style-type: none"> <li>Understand different Ionic structures such as NaCl, Zinc blende, Wurtzite, CaF<sub>2</sub> and antifluorite and use their properties to correlate other inorganic molecules.</li> <li>Study various lattice defects, lattice energy and Born-Haber cycle.</li> <li>Differentiate between ionic and covalent bond using Fajan's rule.</li> <li>Study in detail s-block element and describe the solvation and complexation tendencies of alkali and alkaline earth metals and their functions in biosystems.</li> <li>Explain the diagonal relationship between alkali and alkaline earth metals.</li> <li>Study p-block elements: properties of their hydrides, oxides, oxyacids and halides.</li> <li>learn the properties and preparation of halogens, interhalogens and polyhalides</li> </ol> <p><b>.Paper-II Organic chemistry</b></p> <p>Students will be able to:</p> <ol style="list-style-type: none"> <li>Study about the Stereochemistry of Organic Compounds and determine the absolute configuration of Organic compounds using sequence rules and R-S system.</li> <li>Understand the molecular chirality and optical activity of organic compound and differentiate between enantiomers, diastereomers and meso compounds.</li> <li>Classify the geometric isomers using E-Z nomenclature.</li> <li>Describe the different conformations of ethane, n-butane and cyclohexane.</li> </ol>

	<p>e. Explain the molecular formula, resonance structure and molecular picture of benzene and their stability.</p> <p>f. Recognize the role of activating and deactivating groups in electrophilic substitution reactions of benzene.</p> <p>g. Understand the mechanism involved in nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reactions of benzene.</p> <p>h. Learn about the Nomenclature, methods of preparation, physical and chemical properties of alkyl and aryl halide.</p> <p>i. Differentiate between <math>SN_1</math>, <math>SN_2</math> and <math>SN_{Ar}</math> reactions and explain their energy profile diagram.</p> <p><b>Paper-III Physical chemistry</b></p> <p>a. Understand about solid, liquid and gases solutions.</p> <p>b. Learn about methods for expressing concentration of solution.</p> <p>c. Study about colligative properties and how to calculate molecular masses of unknown substances by applying these properties.</p> <p>d. Study the importance of colloid solution in our life and their use.</p> <p>e. Understand the concept of rate of chemical reaction</p> <p><b>Paper-II Practical chemistry</b></p> <p>Students will be able to:</p> <p>a. Determine the melting point and boiling point of different compounds.</p> <p>b. Learn the crystallization techniques to purify organic compounds by crystallizing various organic compounds such as phthalic acid, benzoic acid, naphthalene and acetanilide.</p> <p>c. Determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at room temperature.</p> <p>d. Study the effect of acid strength on the hydrolysis of an ester.</p> <p>e. Determine the Viscosity &amp; Surface Tension of pure liquids.</p> <p>Determine Molecular weight by Rast method</p>
<p><b>B.Sc -II</b> <b>(Medical/Non-</b></p>	<p><b>Paper-I Inorganic Chemistry</b></p> <p>a. Learn Characteristic properties of d-block elements.</p>

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Semester III**

- b. Properties of the elements of the first transition series, their simple compounds and their use.
- c. Understand the concept of relative stability of oxidation states, coordination number and geometry 3d series.
- d. Study of Electronic structure, oxidation states and ionic radii of lanthanide elements.
- e. Comparative study of Second and Third Transition Series is studied
- f. Magnetic behavior, spectral properties & stereochemistry is understood.
- g. Chemistry of actinides, separation of Np, Pu and Am from U are learned.

**Paper-II Organic Chemistry**

- a. This course will enable the students to study some functional groups like alcohols, phenols, aldehyde and ketones.
- b. To learn the Nomenclature, methods of preparation, physical and chemical properties of alcohols, phenols, aldehydes and ketones
- c. To understand and study Organic reaction mechanism and different types of Name Reactions.

**Paper-III :Physical Chemistry**

- a. Understand the meaning and use of thermodynamics.
- b. Study abouts joules law, zeroth law and their application in daily life.
- c. Understand the importance of first law, second law and third law of thermodynamics in the daily life phenomena.
- d. Learn how to predict feasibility of processes using thermodynamic potentials.

**Paper-I Practical Chemistry**

- a. Determination of acetic acid in commercial vinegar using NaOH, Alkalinity of water sample.
- b. Determination of alkaline content of antacid.
- c. Estimation of calcium content in chalk as calcium oxalate by permanganometry

	<ul style="list-style-type: none"> <li>d. Estimation of hardness of water by EDT A.</li> <li>e. Estimation of ferrous and ferric by dichromate method.</li> <li>f. Estimation of copper using sodium thiosulphate.</li> <li>g. Separation of green leaf pigments (spinach leaves may be used) using TLC</li> <li>h. Preparation and separation of 2, 4-dinitrophenylhydrazones of acetone, benzophenone and cyclohexanone</li> <li>i. Separation of a mixture of dyes.</li> </ul>
<p><b>B.Sc -II</b> <b>(Medical/Non-medical)-</b> <b>Semester-IV</b></p>	<p><b>Paper-I Inorganic Chemistry</b></p> <ul style="list-style-type: none"> <li>a. Know the meaning of various terms involved in co-ordination chemistry</li> <li>b. Understand Werner's coordination theory and its experimental verification.</li> <li>c. Effective atomic number theory is studied.</li> <li>d. Know about valence bond theory of transition metal complexes and its applicability.</li> <li>e. Use of redox potential data-analysis of redox cycle is studied.</li> <li>f. Principles involved water-Frost, Latimer and Pourbaix diagrams.</li> <li>g. Arrhenius, Bronsted-Lowry, the Lux-Flood solvent system and Lewis concepts of acids and bases.</li> <li>h. Physical properties of a solvent, and their general characteristics, reaction in non-aqueous solvents is studied.</li> </ul> <p><b>Paper-II Organic Chemistry</b></p> <p>Students will be able</p> <ul style="list-style-type: none"> <li>a. To study the chemistry of some selected functional groups</li> <li>b. To learn the chemistry of carboxylic acids, derivatives of Carboxylic acids, ethers</li> <li>c. and epoxide, fats, oil and detergents.</li> <li>d. Learn method of formation, Physical and Chemical properties of carboxylic acids, derivatives of Carboxylic acids, ethers and epoxide, fats, oil and detergents</li> <li>e. To understand and study Organic reaction mechanism</li> </ul>

	<p>f. To understand the method of formation, Physical and Chemical properties of nitro compounds, amines .</p> <p><b>Paper-III Physical Chemistry</b></p> <p>a. Learn the importance of electrochemistry and basic definition and their use.</p> <p>b. Understand about galvanic cell and electrochemical cell, their use in daily life.</p> <p>c. Study about the electrodes used in different cells and their working.</p> <p>d. Knowledge about natural electrochemical phenomena is given.</p> <p>e. Understand the processes occurring at surface of electrode such as deposition potential</p> <p>f. Learn the importance of common ion effect and solubility product.</p> <p>g. Study the Voltammetry and conductometric titrations as an analytical tool.</p> <p><b>Paper-II Practical Chemistry</b></p> <p>a. In this course students will be able to analyze the organic sample qualitatively. This will help students to work in some laboratory and find the chemical composition of an unknown organic compound. Students will be able to describe and classify organic compounds in terms of their functional groups and reactivity.</p> <p>b. Qualitative analysis of unknown organic compounds is performed.</p> <p>c. How to detection extra elements and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds.</p> <p>d. How to determine Solubility &amp; <math>\Delta H</math> of the dissolution of benzoic acid at different temperatures. process.</p> <p>e. Learn how to determine the enthalpy of neutralisation of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base. .</p>
<p><b>B.Sc III</b> <b>(Medical/Non-medical)-</b></p>	<p><b>Paper-I Inorganic Chemistry</b></p> <p>Students will be able to:</p> <p>a. Understand and describe the limitations and importance of bonding</p>

**Semester-V**

theories (valence bond theory & Crystal Field Theory) and use them for predicting geometries and properties of coordination compounds.

- b. Calculate the CFSE and predict the experimental behaviour of transition metal complexes.
- c. Differentiate between kinetic and thermodynamic stability and recognize the factors affecting stability of complexes.
- d. Predict the magnetic character of transition metal complexes and measure/calculate their magnetic moments by different methods. Recognize the difference between paramagnetism, ferromagnetism, antiferromagnetism and diamagnetism in complexes.
- e. Assign term symbols and determine the spectroscopic ground state. and Predict the spectra of transition metal complexes using Orgel Energy level diagrams.

**Paper-II Organic Chemistry**

- a. To determine the structure is very important for organic chemist. Various spectroscopic methods are available like NMR, IR, UV absorption spectroscopies are few of them. The students are given a very preliminary idea on these spectroscopies.
- b. Solve problems pertaining to the structure elucidation of simple organic compounds using UV, IR, and PMR spectroscopic techniques.
- c. Understand nature of organometallic compounds their methods of preparations and common reactions.

**Paper-III Physical Chemistry**

- a. Understand the difference between quantum and classical mechanics.
- b. Study the phenomena explained by quantum mechanics i. e. Black, body radiation, photoelectric effect, Compton effect.
- c. Quantum mechanical treatment of one-dimensional box is learned by students
- d. Understand the regions and properties of electromagnetic radiations.

	<p>e. Learn how to calculate bond length using rotational spectra.</p> <p>f. Understand the importance of Vibrational spectra to calculate bond strength.</p> <p><b>Paper-I Practical Chemistry</b></p> <p>a. Synthesize and recrystallize different types of inorganic complexes such as sodium trioxalatoferrate(III), Ni-DMG, copper tetra-ammine and cis-and transbis(oxalato)diaquachromate(III) ion.</p> <p>b. Synthesize and recrystallize different organic compounds as applications of different types of reactions such as Iodoform preparation, aromatic electrophilic substitution reaction of benzene to prepare p-nitroacetanilide and 2,4,6-tribromophenol, diazotization/coupling for preparing methyl orange and methyl red, reduction reaction for preparation of <i>m</i>-nitroaniline.</p>
<p><b>B.Sc -III1</b> <b>(Medical/Non-medical)-</b> <b>Semester-VI</b></p>	<p><b>Paper-I: Inorganic Chemistry</b></p> <p>Students will be able</p> <p>a. To Learn about Classification of acids and bases as a hard and soft, acid-base strength</p> <p>b. Understand bioinorganic chemistry with reference to Essential and trace elements in biological processes.</p> <p>c. Structure and function of haemoglobin and myoglobin, Biological role of alkali and alkaline earth metal ions with special reference to <math>\text{Ca}^{+2}</math>, Nitrogen fixation</p> <p>d. Study about inorganic polymer such as Silicones and Phosphazenes</p> <p>e. learn about the nature of bonding in triphosphazenes</p> <p>f. Learn about the preparation, properties, bonding and applications of organometallic compounds.</p> <p>g. Understand the nature of bonding in metal carbonyls,</p> <p><b>Paper-II: Organic Chemistry</b></p> <p>a. Heterocyclic compounds are very interesting due to their distinct structure and the availability of this kind of heterocyclic structures in medicinal drugs. So the technique of synthesis of heterocyclic compounds is important in the synthesis of different drugs. This</p>

course gives the quantitative ideas about the synthesis, properties and uses of such heterocyclic compounds like pyrrole, pyridine, quinoline, thiophene, furan etc.

- b. Understand synthesis of polymers and their applications in various fields of daily life.
- c. Carbohydrates, starch etc. are different class of macromolecules consisting of preliminary units like glucose, mannose etc. Their structure are also a matter of constant study due to their uniqueness. They are available in different foods like potato and recently they are being used in medicinal sciences also. This course deals with determination of structure of these class of chemicals and also their preliminary units. Inter-conversion of one preliminary unit to other is also discussed here. Learn about carbohydrates, their classification, structure, configuration and their reactions.
- d. Learn amino acids, their methods of preparation, reactions and their stereochemistry
- e. Learn proteins, their structure determination, and structure of nucleic acids and DNA

### **Paper-III Physical Chemistry**

- a. Detailed study about various type of solid is studied.
- b. Methods to evaluate interplanar distance is learned by students.
- c. Determine the crystalline structure of solids using Powder and Lues methods.
- d. Understand about Photochemical reactions and various photochemical phenomena.
- e. Study about Laws of photochemistry.
- f. Learn how to characterize the molecules using electronic and vibrational rotational spectra.

### **Paper-II: Practical Chemistry**

Students will be able to:

- a. Learn column chromatography technique for separation of

	<p>fluorescein and methyleneblue and separation of leaf pigments from spinach leaves</p> <ul style="list-style-type: none"><li>b. Use conductometer for determining the strength of the given acids, solubility and solubility product of a given sparingly soluble electrolyte, study the saponification of ethyl acetate and determine the ionisation constant of a weak acid.</li><li>c. Use pH- metre to determine the strength of the given acid solution.</li><li>d. Determine the molar refraction of methanol, ethanol and propanol.</li><li>e. Study the distribution of benzoic acid between benzene and water, and ether and water.</li></ul>
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